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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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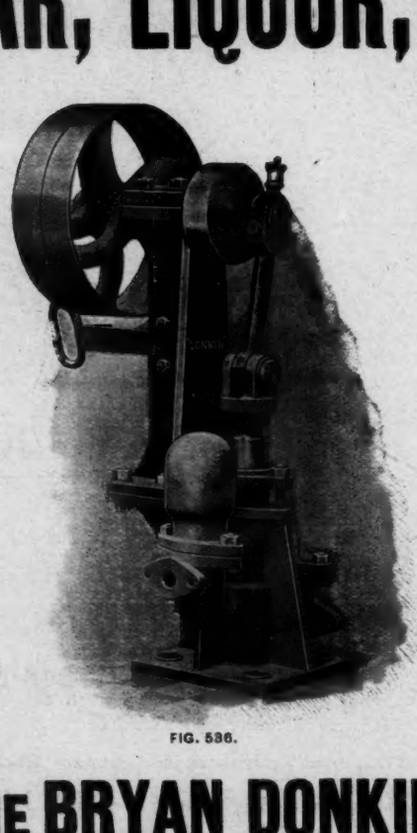

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EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON, E.C. 4.

VOL. CXL., No. 2845.] TUESDAY, NOVEMBER 20, 1917. [69TH YEAR.

EDITORIAL NOTES.

Financial Hardships—Individual Promotions.

IT is understood that the Board of Trade have decided that they cannot go forward with a Public Bill to give relief to those gas undertakings that are, through conditions imposed by the war, suffering severe financial hardships. In the circumstances, those companies who are desirous of promoting independent Bills—some important companies are doing so—may be too late with the necessary parliamentary advertisement; but this need not occasion any worry, because Parliament would certainly condone a late advertisement, in view of the fact that this was due to a circumstance over which the companies had no control—the circumstance being the delay of the decision by the Board of Trade as to whether or not they should promote a Public Bill. We would suggest that any company desiring any further information on the subject should, to save time, at once place themselves in communication with the Gas Companies' Protection Association.

The Inter-related Conditions of the Gas Business.

ARTICLES and reports that appeared in last week's issue were highly suggestive in more ways than one; and this week's issue—more particularly in the "Electricity Supply "Memoranda"—supplements what then appeared. It was shown last week that in economical gas manufacture some remarkable strides are being made, without materially affecting calorific power, while coincidently enhancing the position of the industry as fuel-oil producers. There are workers in these directions who are, with persistence and energy, pressing forward developments in the productive capacity of the gas industry, and not waiting for the results of the more leisurely and extensive research work that is being arranged for or is proceeding in other directions, but which will be equally important through its ultimate defining and permissive results, *viâ* the legislative channel. There is the work of the Board of Fuel Research, of the Gas Investigation Committee of the Institution of Gas Engineers and Leeds University, and of the Utilization of Fuel Resources Committee of the National Gas Council, all directed to the same end—the expansion of the gas-producing capabilities of the industry, and of the service which it renders in all quarters in which heat and power are required, and which expansion the gas industry is shaping itself to promote through not only its provision of gas, but through the better utilization of its coke, and the greater output than heretofore of benzol and fuel oils. All of these developments can take place—there is ample evidence to justify the assertion—without diminishing the combustible character of the gas, and with only a slight percentage diminution of the calorific value, although substantially increasing the make of gas per ton of coal carbonized, with the aid of the coke and steam required by the process of steaming in vertical retorts, or by the mixing of independently produced blue water gas with the coal gas made in horizontal retorts. And, by the way, steaming is trying to prove itself something more than a diluent; it is endeavouring to justify recognition as a subscriber to efficiency inside the retort.

Then the lecture by Mr. Arthur Forshaw and the Inaugural Address of the President of the Institution of Electrical Engineers (Mr. C. H. Wordingham) were illustrative of the enormous scope of business that awaits the gas industry if it realizes to the full its opportunities, and does not through unconcern allow those who are looking with envy upon the possibilities of the industry to usurp territory which should naturally be occupied by it. We have never known the industry to offer a more alluring prospect than to-day, nor to so clearly indicate the lines of development, or the means by which that development can be fostered. If the gas industry is not prepared to fashion its processes in manner that will give what is required by manufacturers for heat and power purposes generally, then the rivals that are not only hard on its heels, but are actually already contesting for custom, will deprive it of a considerable part of that large-class business which holds within it so much that should prove to be an economic asset to the industry. Nor must we confine observation to industrial need. For providing power for vehicular purposes, opposition to the industry's progress is keen, and the keener because of the recognized potentiality of its position. Also in connection with the cooking load, we have seen isolated examples of the introduction in large business establishments of electric-cooking apparatus. The disabilities under which such apparatus labours are well known to most gas men; at the same time, it is those large establishments that can show by electrical operation the highest results in economy as compared with itself in less propitious circumstances. We have to bear these movements in mind in considering the necessity for more economical production, and the realization of the largest possible revenue per ton of coal carbonized. Economical gas production and paying developments in the yield of commodities per ton of coal, are the best possible protection and stimulus that can be given to the rate of the advance in business done and new territory occupied.

This brings us to the point as to the business of the gas industry possessing a common and indivisible front; for every constituent part of it has an economic bearing upon all the other parts. Herein, the gas industry owns a position superior to that of its rivals, on which it can build if it so wills. The strength of its position lies not only in its statutory privileges in respect of domestic supply and also industrial service—in the latter, however, only so far as general distribution is concerned, inasmuch as every big manufacturing establishment can have its own gas-producing plant—but in the diversity of its business in gas, and in that of the commodities with which it deals. The greater the diversity of demand and of commodity from the one raw material, the greater the stability of the business, and the better value that can be given for money with normal conditions prevailing. For example, the domestic gas business must profit by the expansion of the industrial gas business; and the industrial gas business by the extension of the domestic business, the largest possibilities in which to-day lie in room heating and hot-water supply (the cooking field being already pretty well occupied). Another advantageous condition is that the characteristics of the gas required for industrial heating and power are precisely those needed for the largest domestic developments—not necessarily gas of high calorific power, but certainly one that contains as low a percentage of incombustibles as possible, thus giving a good flame temperature, and supplied at a pressure that will wholly satisfy consumers' requirements at all points.

In this position we have, as the Prime Minister would put it, a common front—all parts being interconnected and reactive. The "JOURNAL" has always stood for this oneness in the gas industry, by treating with fullness its technical and commercial interests week by week as an inseparable whole; while very properly leaving to the British Commercial Gas Association the task of reaching manufacturers and other consumers by the organized means which it possesses in better degree than anyone else. The manufacturers in the various industries of the country do not, as a rule, subscribe to technical papers devoted to other industries, any more than do the domestic users of gas or coke who

are not technically or financially concerned. Special means have to be utilized to reach them through their own technical and commercial organs. Those whom the technical papers of an industry such as that of gas supply reach are the professional men and administrators of the business, members of the staffs, those interested financially as shareholders, manufacturers of plant and appliances, those providing the various materials required by the industry, and those who deal in secondary products of gas manufacture. Beyond them the technical gas paper does not go. Their interests are identical; and the information they require is therefore all more or less inter-related, seeing that progress in the main direction affects the prosperity of all. Hence the oneness of conditions, and the oneness of interests; and therefore the needlessness of assuming, or attempting to create, an individuality for one section of the business more than for another. The gas business, we repeat, has a common front. Along it work is going forward in a highly promising manner; and if the whole industry rises to its opportunities, a fullness of progress will of a surety be its reward.

Further Reflections on the Southern Association Carbonization Discussion.

IN a letter in our "Correspondence" columns, Mr. John West supplements the information he gave when replying to the discussion upon his paper before the Southern Association, which paper is acknowledged by every competent judge to be a notable contribution to those subjects that are engaging technical thought in our industry, with in view prospective developments. We do not think that any good can result from further discussing what the Ministry of Munitions did or did not recommend as to the method to be tried for realizing a larger production of fuel oils. But Mr. West is entitled to a reply to the revival of the matter by Mr. W. Doig Gibb; and now it might well end, as professional gas men are pretty well occupied to-day in dealing with the requirements of the present, and considering and working upon the problems affecting the future. It may, however, be said that it has been established beyond any doubt that low-temperature carbonization from the points of view of gas makes, divesting the coke as far as is practicable of valuable volatile matter, the capital employed, and the labour charges, can be safely set on one side without further present consideration by the gas industry. Every gas man and every scientist and chemist—such as Dr. F. Mollwo Perkin—who goes into the subject thoroughly, though some of the latter may at the threshold of their consideration have been allured by the idea, have left it convinced as to its commercial impossibility for the gas-supply industry. It is only the flighty and superficial visionaries who, careless of complete investigation, cannot disentangle themselves from their first attraction, and so continue to blindly stick to their ill-founded hypothesis. The position is well put (from the gas, coke, and liquid products standpoints, without, however, considering the important questions of capital and labour) by a writer in the last issue of the "Engineer." He points out that to-day the demand is for products of an aromatic nature—hydrocarbons of a benzenoid character—while, in the tar evolved from average coal at moderate heats, paraffin bodies and the higher tar acids are prevalent. In the gas itself from low-temperature working, paraffins such as ethane and propane predominate; whereas the essential constituents are benzene and its homologues. In view of these facts, and of the further one that there is a great sacrifice of the primary product, the writer in our contemporary is of opinion that the provision of paraffins might well be left to the shale and oil industries, particularly if by such a policy gas-works are enabled to concentrate on the establishment of a home supply of lighter spirits. Sir George Beilby, the Director of the Board of Fuel Research, will recognize the importance of this.

In considering these matters, however, we must not overlook the fact that we have to keep gas production right in the forefront; and the secondary products must necessarily take their natural place. As it happens in the developments that are going forward, they are doing so very successfully. In determining upon the system of carbonization to be adopted in the future, it will not be a question of selecting the one that is most advantageous at the present time, as the one that will under normal conditions produce the largest total revenue (subject to the price of gas) from every ton of coal handled. It may be that the method that, given a high production of gas of good composition, will supply the largest quantity of fuel oils will be the more profitable one. With both vertical and horizontal retorts, variations in the character of the products are largely a matter of temperature, exposure to extreme heated surfaces, and quality of coal. But it has to be confessed that with continuous vertical retort working, there is, for the purposes of the explosives and dye industries, an undesirable quantity of the paraffinoid bodies—just as there is, but in still greater degree, in the products from the low-temperature carbonization systems. But as Mr. Thomas Glover pointed out last week, it is probable that in peace times sufficient raw material for both explosives and dye purposes will be obtained from coke-oven tar. One authority recently, in considering the future of the benzol market, calculated that the chemical and dyestuff industries would not absorb more than 5 or 6 million gallons per annum of the 60 million gallons or so within sight from gas and coke-oven plants—this, of course, assuming that all gas-works adopt and continue the oil-washing process, although not removing from their gas more than (say) one gallon of benzol per ton of coal carbonized. This indicates that the future of the gas industry in this respect lies largely in the fuel oil market, which is one that is going to extend tremendously through the requirements for internal combustion engines for vehicular and other purposes, while the heavier oils will find an important outlet for national purposes. Hence the point made by Mr. West in his letter: "Although [continuous] "vertical retorts give less hydrocarbons of the benzene "series and more paraffins than horizontals, it must not "be forgotten that a larger quantity of burning oil can be "procured by the verticals than by the horizontals. The "figures were given by Dr. Colman in the ratio of 7¾ gallons "to 3 gallons. These figures I can substantiate." The result for vertical working is with steaming, and the conditions described in Table VII. of the paper. However, the yield of fuel oils is a consideration to be kept well in mind, as it bears upon the economy of the net manufacturing cost of the primary product, about which so much that arrested interest and occasioned surprise, in regard to gas volume and calorific value, was given in Mr. West's paper and during the discussion upon it.

One other matter. Mr. West alludes to Mr. G. M. Gill's references to what the South Metropolitan Gas Company do in regard to the limitation of incombustibles in their coal gas—not permitting them to exceed 10 p.ct. of nitrogen and 2 p.ct. of carbonic acid and oxygen—together 12 p.ct. This figure is very close to the one that meets Mr. West's approval. He and several other gas engineers are of opinion that they could keep within 12½ p.ct.; at the same time, with a liking for something in hand, the veteran engineer would prefer a margin of 1½ p.ct. for emergencies, so putting the limitation at 14 p.ct. We do not fancy further regulation. The Board of Trade, however, have referred the matter of gas composition to the Board of Fuel Research, and the future is largely in their hands, combined with which is the knowledge of the authorities as to the abuse that has existed in some quarters. So the probability is that the sins of the negligent and unconscientious will be visited upon the careful and the conscientious. The verdict as to whether or not there shall be restriction in regard to inert constituents, and the decision as to the degree of the restriction, rest to-day not with gas men, but with others.

The Scottish Gas Council.

THE proposal for a Scottish Gas Council is going forward, but under conditions far more acceptable and commendable than formerly seemed to be probable, in view of certain of the speeches made at the last meeting of the North British Association. At the time, we offered some criticism upon the proposal, and suggested among other things that the functions of the new body should, if formed, be advisory and consultative, and that it should work in conjunction with the National Gas Council. Also that a title other than the "Scottish Gas Council" would be less misleading, inasmuch as it infers the existence of a "national" body looking after the interests of the industry in England, Wales, and Ireland, with an independent one for Scotland. In this, there was, and is, an apparent weakening of the status of the National Council as representative of the gas industry of the United Kingdom, while at the same time not doing any good to the Scottish part of the industry, through its suggested detachment from the Council recognized by Government departments and other bodies as acting and speaking for the entire

industry. The Special Committee to whom the matter was referred have now framed the constitution and rules; and we reproduce them in a later part of this issue. They are subject to confirmation at a special meeting of the Association to be held on the 28th inst.; so that there may yet be changes in them.

It will be remarked that the suggested name—"Scottish "Gas Council"—has been adhered to; so that our former criticism remains. To all who are not aware of the principle that has guided the Special Committee in the framing of the rules, the title will give a somewhat false conception as to the position occupied by the Scottish Council. The idea will continue to be independence, and not association and co-operation; although *de facto* this is the fundamental principle in the establishment of the new body. On this ground (apart from the title), we heartily welcome it, and assuming there is no change in the rules, and the scheme is adopted, we wish it every success in the best interests of Scotland. Right in the front is the acknowledgment of the premiership of the National Gas Council. The Scottish Council, the rule says, "shall be associated with the National Gas "Council, and will recognize that body as the pre-"mier Council in dealing with matters of common in-"terest and importance to the gas industry as a whole." Then there is the reservation: "But the Council [*i.e.*, the "Scottish] shall deal separately and independently of "the National Gas Council so far as affairs of purely "Scottish interest and concern demand, but may refer these "matters to the National Gas Council for advice and assist-"ance in dealing with them." With the acknowledgment, the pledge, and the line of demarcation plainly drawn, the strongest objections to the proposal as it was left by the discussion (with in parts an unpleasant smack about it) at the last meeting of the Association are removed; and there is really only the title that should be modified. Otherwise, no one can have any reasonable objection to the scheme as now presented. The constitution of the Council is cast upon broad lines; and technical and commercial organizations as well as municipal and company undertakings, and policy and finance, will be well represented. If established, from the new organization being coadjutant with the National Gas Council, the Scottish undertakings should materially benefit.

Quick Revolution Vertical Gas-Engines.

THE descriptive paper Mr. V. E. Green read, on "Quick "Revolution Gas-Engines," at the meeting of the Midland Junior Gas Association last Thursday, comes as a reminder that gas-engine design and improvement are not standing still. In fact, those intimately concerned with research into, and development of, internal combustion engines are as hopeful as ever of increasing the maximum sizes of the vertical type (which have displaced engines of the horizontal order for the higher powers), even if the successful gas-turbine appears to be still lurking away in a dim and distant future. This type of engine has done much for gas; and without its development, we are afraid that, for the use at all events of town gas, there would have been confinement to much lower power engines. Another consideration is that the engines give considerably more power on a given floor space than is possible with the horizontal type; and this is a consideration in factories. Further, with them the flywheel is smaller than with the horizontal engine; and a remarkably even turning moment is obtained, which makes the engines particularly suitable for use for the generation of electricity. In this direction (of course we are speaking of the higher horse powers) they have succeeded where the horizontal type would not have done so, with the nicety of requirements which such work demands. Besides, as Mr. Green states, the range of the applications of such engines is now being very largely extended—through their superior running. For different gases, of course, some modifications in design are necessary. But now that town gas is being so largely denuded of those very hydrocarbons that, when it was of higher illuminating quality with the open flame, used to give some amount of trouble and called for special attention to piston design, this should help it to realize more business in the higher horse powers, particularly with the lower prices at which it is hoped to sell as the economies of production extend.

Quick revolution engines are by no means new; but the paper indicates that several improvements in details have been effected since attention was first turned to them. Mr. Green emphasizes the importance of lubrication in ensuring their satisfactory running, and naturally, seeing that the more rapid the movements, increased friction and higher temperature would result without care and a sure method of lubrication be applied. Mr. Green does not mention the lubricating oil that he prefers; he simply describes it as of a mineral variety. But he does state that the oil temperature rises to about 150° Fahr. Though at this temperature, most oils would begin to vaporize, no trouble or a high consumption is suggested. The author merely says that, if the 150° Fahr. is "much exceeded," due to engine-room conditions, it is necessary to cool the oil; while the consumption, under good conditions, is as low as 1½ gallons per twenty-four hours on a 400 B.H.P. engine. There is a considerable difference in lubricating oils, and a wide difference in conditions of use; and as, with quick revolution engines, the conditions are somewhat drastic so far as the oil is concerned, the specification of a suitable and economical oil is a matter of importance. Regarding the cooling water, it is noticed that the author says the temperature of the water leaving the engine should not exceed 140° Fahr., and allowing for a rise of the inlet temperature of (say) 80° Fahr., "will necessitate about 6 gallons of water per B.H.P. hour" —that is to say, if the water were run to waste. We take it the actual waste in the case of these engines would be about covered by 5 p.ct. The heat consumptions and mechanical efficiency of the engines are good. We believe that the guarantees are usually put at 10,000 B.Th.U. per B.H.P. hour, so that Mr. Green's 9500 B.Th.U., when running at full load and under good conditions, is well below this. At half and quarter loads, the heat consumptions would be about 12,000 and 14,000 B.Th.U. respectively per B.H.P. hour. Of course, these figures depend largely upon the composition of the gas; and there will be interest in having careful tests carried out on town gas partially stripped as well as mixed gas obtained by steaming in continuous vertical retorts. Indications by Mr. John West and Mr. Lawrence Hislop suggest [*ante*, p. 318] with ordinary engine working, using gas made by that method, there is a reduction of the quantity of gas used, and therefore it follows of the B.Th.U. per B.H.P. hour. Anyway, the gas industry is now on the road to developing a gas which should intensify its interest in engines of larger powers.

Neglecting Ministry of Munitions Returns.

IT will have been seen from the report in our "Legal "Intelligence" last week that the Secretary and Manager of the Longridge (Lancs.) Gas Company, Mr. James Lee, has learned that we are at war, and not at play, and that wilful negligence of the requests of Government authorities acting under the Defence of the Realm Act is not to be tolerated. He seems to have been ignorant or careless of these facts, and, as a result, has brought public disgrace not only upon himself, but upon his Directors and Company, who, though responsible, were the victims of their Manager's neglect. It must have been with the greatest reluctance that the Ministry of Munitions instituted the prosecution; but, in view of the persistent inattention to their letters, they had no alternative. The Ministry are considerably harassed in their work—heavy as it is, even if it proceeded with clockwork regularity—by utter indifference to punctuality in response upon the part of some from whom they desire returns; and work is consequently increased, and its completion delayed. In such times as these, anything that a man can do to assist the authorities should be done promptly, so as not to waste the time of the country, and increase the weight of responsible and imperative work. In addition to the circular-letter regarding coal tar, Mr. Lee, through his persistent negligence, compelled the Ministry to write him no less than three letters; and, according to the statement made by Counsel, only a summons appears to have had any rousing effect, and induced a recognition of duty. We do not think Mr. Lee improved matters by only acknowledging the receipt of one letter. It would be strange if so many letters to Longridge from a Government Department went astray; if they had not been delivered, they would have been returned by the postal authorities to the Ministry of Munitions. But they were not so returned. Out of some 1500 concerns to whom the circular-letter was addressed, this one at Longridge was the worst offender. However, the fines that were imposed—amounting in the total to £75 10s.—should have a salutary effect; and the case should act as a warning to others who are lacking in a sense of responsibility in such matters as the one now in question.

What of the Prepayment Meter?

The Decimal Association are elated. At a joint meeting of the Institute of Bankers, the Association of Chambers of Commerce, and the Decimal Association, unanimous agreement has been secured as to the retention of the pound sterling as the monetary unit, and its division into 1000 parts or mils. To secure the adhesion of the Institute of Bankers and the Association of Chambers of Commerce is an important advance for the decimalists. However, the proposal is interesting, inasmuch as, with the exception of the shadow of a discrepancy at the second place beyond the decimal point, it enables all existing gold and silver coins down to and embracing 6d. to be retained without alteration of their respective values. For example, the 6d. is represented by 25 mils, or, rather, 25·02, to be strictly accurate, but the 25 is near enough. The copper coinage is the trouble. The masses do an immense amount of business with copper coins, including the purchase of gas; and the purchase of gas represents millions of prepayment meter mechanisms in the homes of our working people—all arranged for coins of the size and value of the penny. The equivalent of the penny in mils would be 4·17; and so it is clear that the adoption of this proposal would upset entirely the basis of the small-class gas business (which is a huge thing in the aggregate), as well as the mechanisms of the millions of prepayment meters. It is intended that the coins of lower denomination than the 25 mil (equivalent of 6d.) should be in 1, 2, 3, 4, 5, and 10 mil pieces. The 5-mil piece would be the handiest coin for prepayment-meter transactions; but, alas! it is proposed that it and the 10-mil piece shall be in nickel. So between values and the nickel, if this scheme is adopted at some time or other, we shall, in the gas industry, be let-down pretty heavily.

Coal and Coke Exports.

The tale proceeds of reduced coal, coke, and patent fuel exports, with good values attaching. The Board of Trade returns show that in October 3,180,922 tons were sent abroad, which was a reduction of 527,378 tons on the corresponding month of last year, and of 590,147 tons on that of 1915. The total value last month was £4,463,028, or £412,705 less than for October, 1916, when, as shown above, 527,378 tons more were sent abroad. But in comparison with October, 1915, the value last month was £1,047,616 greater, though 590,147 tons more were exported in the 1915 period. The value averaged £1 8s. per ton last month, as against £1 6s. 4d. in October, 1916. For the ten completed months, 32,619,757 tons were shipped—a reduction of 2,531,415 tons on the corresponding period of 1916, and of 6,210,849 tons on the ten months in 1915. The value for the past ten months was £43,948,383, or £1,061,663 more than in the same period of 1916, and no less than £11,379,112 higher than in the ten months of 1915—for, in the latter case, 6,210,849 tons less.

The History of Delayed Conveyor Renewals.

Operations at the works of the Peterborough Gas Company are in a critical position, and all due to delay in securing hot-coke conveyor renewals. We know of the grave difficulties of the authorities in respect of materials and men, and of the supremacy of war needs. At the same time, in the matter of priority certificates, with their various classes, and a long line of "Ps" attached, there does seem to be some lack of appreciation as to the relative importance to other works of gas-works, with all they are doing for the national cause, while at the same time carrying-on, handicapped with short staffs, their ordinary work of supplying light, heat, and power—all essentials to the life of a community. If there are any works that should stand high in priority for really necessary renewals or extensions, they are gas-works; but, as a matter of fact, they seem to get placed rather low down in the scale. It would be interesting to know what are the nature and claims of the work (other than that for the war) that has precedence. A conveyor, whether for coal or coke, takes the place of men. The Peterborough Gas Company's works have been deprived of men down to the irreducible minimum, and on the basis of the services of a coke conveyor being available. A coke-conveyor that represents men must be maintained and, when necessary, renewed; and renewals were required by the Peterborough coke conveyor as long ago as the early part of the summer of 1916. On June 16 of that year—seventeen months since—an order for renewals was placed, with a Class "C" certificate. Finding that Class "C" was practically useless, the Directors and Mr. John Barton (the Engineer and Manager), on July 28, 1916, had an interview with Dr. A. E. W. Hazel, of the Ministry of Munitions, when the work was raised to Class "B." Another winter had to be faced with the ill-conditioned conveyor. Then on May 31 last, after much correspondence, the work was transferred from Class "B" to P5; but the latter appears to be little better than Class "B." During the early part of June last, Messrs. Perkins Engineers Ltd., of Peterborough, interested themselves in the matter, because the Company were unable to give them the full pressure of gas they required. The result was a P4 certificate, which has been sent on to the contractors. This, however, seems of little use, as P1, P2, and P3 have precedence. The position of the Company is, as remarked above, most critical, not only with regard to the supply of gas, but also with the men. The matter was recently mentioned in the House of Commons by the member for the borough [see *ante*, p. 280]; but a very indefinite answer was given. The long delay in assistipg the work forward appears altogether unreasonable. And already we have jumped into another winter, and the period of heavy gas demand. This is a case that should certainly now receive special consideration and treatment at the hands of the authorities.

A Labour Alliance.

Having decided on the lines of action, it may be assumed that no time will be lost in getting to work by the National Alliance of Employers and Employed. At a meeting last week, the constitution of the machinery and a programme were adopted. The main features of the former, as decided upon, are a central council, an executive council, and district committees, which ought to be composed of employers and representatives of labour in equal numbers. It is intended that the organization shall not, unless specially requested to do so, interfere with arrangements existing between employers' associations and trade unions for the settlement of questions affecting wages and hours and conditions of labour. Even so, the objects of the Alliance are sufficiently ambitious to ensure a life of great activity if their attainment is to be resolutely sought. The first of them is to promote active co-operation of employers and employed in the treatment of questions generally affecting labour and employment in all trades and industrial occupations; the second, to promote the welfare of the industrial workers of the country and efficiency of its industries; and the third, to promote arrangements for facilitating the reinstatement in civil employment at the end of the war of men serving with the forces and of munition workers. On the programme, one finds at the head a living wage and regulation of hours of labour; and then, among a number of other desirable things, "to press locally and nationally that every child shall have the opportunity of obtaining a liberal education and the technical training required for the particular calling for which it is shown to be fitted." The meeting was presided over by the Right Hon. Frederick H. Jackson, who appealed for the cordial and whole-hearted co-operation of all classes, so that the productive capacity of the country should be increased and maintained to its fullest extent. Undoubtedly, most, if not all, of the aims that are set forth by the Alliance will be capable of fulfilment with the realization of the facts that there must be high wages, shorter hours, and better housing and education, and that, on the other hand, "labour must be prepared to give a full day's work for a full day's wage, and to assist the management in every possible way to secure the largest output at the lowest possible price."

Coal Mines Control.

When the Coal Mines Agreement (Confirmation) Bill, to which allusion was made last week, was before the House of Commons for second reading, it transpired that the dissentient coalowners represented some 100 million tons of the total output of 250 million tons; so that it is clear the Bill has a considerable backing, and so have the Mining Association and the Coal Controller, who were parties to the agreement. Naturally the dissentients had most to say when the Bill was under consideration. When knights are bold connected with the coal industry is when their financial interests are to be assailed; and knight after knight interested in coal jumped up, and had his say on the iniquity and nebulousness of the agreement. In the view of these gentlemen, it is steeped in inequity; but the producers of three-fifths of the coal output are willing to loyally accept it. The terms are

pre-war profits (and fat ones some of them were), with 5 p.ct. of the excess profits. This is where the agreement pinches. Some collieries have during the war been dividing more than their pre-war profits, which tells a tale of increased revenue, despite the Price Limitation Act; and they are aggrieved over having to lose the 15 p.ct. excess profits beyond the 80 p.ct. of which other people are relieved, even though the 15 p.ct. is going to be utilized in guaranteeing and paying the pre-war profits where adverse circumstances, or the closing of mines through the action of the Government, do not allow these profits to be made. It transpired that it is confidently believed that the 15 p.ct. will be sufficient to meet any calls in this direction, as well as to pay the administrative expenses of the Controller's office. This suggests, too, that excess profits have not been lacking in the coal industry; and the Coal Controller knows what he is about, having had a number of chartered accountants investigating the position. Moreover, we see that Mr. Bonar Law, the Chancellor of the Exchequer, states that, when the proposals were brought before him, he made it perfectly clear that, whatever the arrangement, it must be one which would not mean a demand upon the Exchequer to carry it out. In face of this, the Board of Trade would not have made themselves responsible for a measure that did not adequately provide for bearing its own financial burden. However, notwithstanding much talk by the dissentients—with little solid criticism in it, no alternative proposals, and no suggestion that the colliery owners in the actual dividends they would receive were not doing remarkably well in comparison with many other people who work harder and whose personal responsibilities are greater—the Bill was read a second time, and committed.

PERSONAL.

Mr. ROBERT BARR, jun., Assistant Gas Manager to the Kilmarnock Corporation, has been appointed Manager of the Ardrossan Corporation Gas-Works.

Corporal ERNEST SPEIGHT, who before joining the Colours was employed by the Harrogate Gas Company, has been awarded the Military Medal. He enlisted early in the war, and has been out in France over two years.

Sir HALLEWELL ROGERS has been re-elected Chairman of the Birmingham Corporation Gas Committee; and at the last meeting he was cordially thanked for his services during the past year. Sir Hallewell, who is an Alderman, and has been Lord Mayor of Birmingham, is one of the best-known business men in that city.

An Oldham Masonic Ceremony.

There occurred recently an event said to be unique in the history of Freemasonry in Oldham, when brethren of the Friendship and other Lodges gathered for the purpose of doubly congratulating W.Bro. Joseph Braddock—first, on the attainment of his 80th year; secondly, on a record of over fifty years' honourable connection with Freemasonry. To mark the occasion, it had been proposed to present him with a portrait of himself in oils; but as he preferred that any effort made should be devoted to charity, the Lodge initiated a "Joseph Braddock Fund for Charity," which was opened with a subscription of £105 to the East Lancashire Systematic Benevolent Institution. In addition, W.Bro. Braddock was presented with an illuminated address printed on vellum, recording the establishment of the fund. W.Bro. E. Davies, who presided, mentioned that Bro. Pickford had been responsible for the suggestion that the Friendship Lodge should mark the occasion; and other Lodges then expressed a desire to participate. Both he and Bro. Pickford spoke in the highest terms of W.Bro. Braddock, who, in responding, gave some interesting reminiscences of his connection with the Craft. He mentioned that his ancestors came from Mottram to Oldham; and his grandfather became connected with the Friendship Lodge in 1830. He himself was elected a member on Dec. 26, 1866. About 1886, his eldest son was initiated in the Lodge, and two or three years later his second son.

British Association of Chemists.—There was a very large attendance in Manchester last week at a meeting convened for the purpose of inaugurating a British Association of Chemists. Dr. Alfred Rée presided; and among the speakers was Mr. E. W. Smith (the Chairman of the Provisional Executive Committee for the Birmingham District), who remarked that the meeting proved that there was an urgent demand for a body which should be the sole registration authority for chemists. The Provisional Committees, he said, strongly urged that they should go straight ahead with all possible energy to the formation of the Association, as if the Institute of Chemistry did not exist, but leaving themselves open to be swallowed up by the Institute, if the Institute would swallow them. They thought that in the near future the Institute would modify its ways considerably in keeping with the times.

SCOTTISH GAS INDUSTRY.

Formation of a Gas Council.

AT the last annual general meeting of the North British Association of Gas Managers, the matter of forming a Scottish Gas Council was dealt with; and after deciding that such a body should be established, it was remitted to a Special Committee of the whole Council of the Association, along with Mr. Alex. Wilson, of Glasgow, Mr. A. Masterton, of Edinburgh, Mr. A. Yuill, of Dundee, and Mr. S. Milne, of Aberdeen, to draft a Constitution and Rules. The Committee met in Glasgow last Wednesday, and, as a result, the following Constitution and Rules were agreed to. These will be submitted for approval to a special meeting of the North British Association, to be held on Wednesday, Nov. 28, at three p.m., in the Hall of the Royal Philosophical Society of Glasgow, No. 207, Bath Street, Glasgow.

SCOTTISH GAS COUNCIL.

Constitution and Rules.

(1) *Name.*—The name of the Association is the "Scottish Gas Council," and it is hereinafter referred to as the "Council."

(2) *Objects.*—The objects of the Council are:

The Council shall be associated with the National Gas Council of Great Britain and Ireland, and will recognize that body as the premier Council in dealing with matters of common interest and importance to the Gas Industry as a whole; but the Council shall deal separately and independently of the National Gas Council so far as affairs of purely Scottish interest and concern demand, but may refer these matters to the National Gas Council for advice and assistance in dealing with them.

The Council shall not deal with matters which are properly the business of the North British Association of Gas Managers, the Waverley Association of Gas Managers, or the Commercial Sections of the North British Association; but these bodies may refer matters to the Council to be dealt with by them.

(3) *Constitution.*—The Council shall consist of a President, Vice-President, and Members.

1. The President and Vice-President shall be elected by the Council.
2. The President and Vice-President shall continue in office for one year, and shall be eligible for re-election, but shall not hold office for a longer period than two consecutive years.
3. The appointment of President and Vice-President to be made at the annual meeting, when nominations may be made, and candidates will be voted upon by show of hands, or by ballot as may be decided upon.
4. The members shall be: (*a*) Two members of the Council of the North British Association of Gas Managers to be appointed by the Council of that body; (*b*) two members of Committee of the Waverley Association of Gas Managers to be appointed by the Committee of that body; (*c*) two members from each of the two Commercial Sections of the North British Association—"Western" and "North-Eastern"—to be appointed by the respective sections; (*d*) the gas managers and gas conveners for the time being of Edinburgh, Glasgow, Dundee, and Aberdeen; (*e*) the managers of four representative gas company undertakings, whose appointment shall be made by the Council of the North British Association of Gas Managers; (*f*) the conveners of four corporation gas undertakings, and the chairman (or a director) of four company gas undertakings, whose appointment will be made by the Council. The appointment of members of the Council shall be for a period of two years, and the members shall be eligible for re-election with the exception of the appointment of the gas managers and gas conveners of Edinburgh, Glasgow, Dundee, and Aberdeen, whose appointment shall be permanent. The Council to have power to co-opt for any special purpose the services of anyone who is not directly represented on the Council.

(4) *Meetings.*—An annual general meeting of the Council shall be held in October of each year to receive reports, for election of President, Vice-President, and Secretary, and to appoint the Executive Committee, and to transact such other business as may be necessary.

Ordinary, or emergency meetings of the Council shall be held at such times and at such places as may be fixed. Five members shall be necessary to form a quorum.

(5) *Executive Committee.*—An Executive Committee shall be appointed from the members of Council, and shall consist of seven members. The Committee shall appoint a Convener. Three members shall be necessary to form a quorum.

The Executive Committee shall meet as and when necessary for the purpose of dealing with special matters which may be remitted to them by the Council; but they shall have power to deal direct with matters of urgency and importance requiring to be promptly dealt with, and to report to the Council. But the Executive Committee shall have full power to deal with such matters of importance; but this will be governed by the urgency and exigencies of the moment.

(6) *Secretary.*—The office of Secretary to be honorary, the appointment to be made annually by the Council, and the person appointed shall be a member of the gas profession, but he shall not have a vote in the affairs of the Council.

(7) *Voting.*—The Chairman at any meeting of the Council, or the Convener of the Executive Committee, shall have a casting-vote in addition to a deliverative vote.

Every member attending a general or ordinary meeting of the Council, or of the Executive Committee, shall have one vote.

(8) *Minutes.*—Minutes of the proceedings of all meetings of the Council, and of the Executive Committee, shall be taken by the Secre-

tary, and shall be properly recorded, and read at the next meeting, and when confirmed shall be signed by the Chairman of the meeting.

(9) *Alteration of Rules.*—The foregoing rules shall remain in force until altered, added to, or rescinded by a resolution of the Council passed at the annual general meeting, but only if (1) intimation of the proposal has been lodged with the Secretary fourteen days previous to the annual general meeting, and such intimation has been given in the notice calling the annual general meeting; (2) the resolution has been carried by a majority forming two-thirds of those present at the meeting.

TURIN GAS CONSUMERS' COMPANY'S REPORT.

NOTWITHSTANDING the war and the difficulties and trials inevitably brought in its train, we have received as usual from our Italian friends in Turin the annual report for 1916-17 of the Societa Anonima dei Consumatori di Gas-Luce. In April last there came into force a legal decree limiting to a few hours a day the consumption of gas. The effect of this was naturally a marked reduction in the output; so that the gas sold fell by 2,670,898 cubic metres, representing a falling off of about 25 p.ct. compared with the year 1914, or to a figure approximate to that of the gas consumption during 1916. Nevertheless, every confidence is expressed that the return to normal times will show that this loss is merely temporary, and that the vitality of gas and its multifarious uses will then rapidly overtake the set-back now suffered. As is well known, Italy's difficulties in regard to coal have been considerable; and at one time the stock was only sufficient for a few days' needs. Energetic efforts were, however, made; and these resulted in January last in the State supplying gas-works with the necessary coal at 165 lire per ton—receiving in return the bye-products required at fixed prices. By these means the position has been much relieved; adequate supplies have been secured, and future working rendered less anxious and safer.

[We are glad to take advantage of this opportunity to express, not only to our gas colleagues in Turin, but to all our friends of the Italian gas industry, our warm appreciation of the past achievements of our Italian allies in arms, our practical sympathy with them in their present difficulties, and our full confidence in their future successes.]

ELECTRICITY SUPPLY MEMORANDA.

THE question of an alliance between the gas and electricity industries is vibrating thought in the latter, but few public expressions of opinion result. The fact is that some of the professional men of the electricity industry hardly know what to make of the trend that things are taking towards the source of their fuel supply being the natural one of the gas industry. The Board of Fuel Research, in their recent report, indicated this as a possible development; the National Gas Council the other week, in the part of their report treating of the work of the Utilization of Fuel Resources Committee, referred to conferences with scientific and electrical authorities regarding co-operative working, especially on the lines of gas-works supplying the electricity industry with heat units; and on top of this came the pronouncement of opinion by the new President of the Institution of Electrical Engineers (Mr. C. H. Wordingham), to which allusion was made in our editorial and subsequent columns last week. All this is significant. But there is something else that is still more significant. It is that Mr. Wordingham is not disposed to wait for the issue from any investigation made by the Board of Fuel Research. He is so much persuaded that the alliance between the two industries is the right course to pursue that he, as Consulting Engineer to the Leicester Corporation on their scheme of new electricity works, has boldly advocated that the steam-raising shall be by gas produced at the Corporation gas-works. Here is a grand opportunity for Leicester leading the way in a big development in fuel economy; and, in the national interests, the Government Departments concerned ought to let Leicester have whatever loans are required as soon as Mr. Wordingham and the Corporation are ready to proceed with the scheme, in order to provide a lesson in this direction on the grand scale. Mr. Wordingham is enthusiastic. He was invited to address the Town Council on the subject of the scheme. Said he: "The greatest economy of fuel would be gained by cordial co-operation between the gas and electric interests." The town, he added, is fortunate in having both concerns in its own hands, and so are able to secure the co-operation, and to develop the two concerns side by side. What is more, Mr. Hubert Pooley, the Gas Engineer, has also had under his charge an electricity station—that was before going to Leicester; so he knows the requirements. The Council have agreed to take the first step towards carrying-out the scheme, by negotiating for the purchase of a site. The position for the gas industry has been altogether changed by the transfer from an illuminating power standard to a calorific value one; and if our electrical friends will only consider what is going forward in the gas industry in connection with steaming in vertical retorts [see first editorial in last week's issue and the paper and discussion at the Southern Association meeting] and the gasification of coke, producing a 90 p.ct. and upwards combustible gas of 300 B.Th.U., and from 50,000 to 60,000 c.ft. to the ton of coke, they will appreciate much as to the lines of economical gas manufacture now well upon the road to practical materialization.

Alliance for Fuel Supply.

Heating and Gas-Production Developments.

This position of gas-production development has a large bearing upon what Mr. Wordingham said in his address as to the supply of heat for warming and cooking. We will not argue with him as to whether electric cooking will "probably" be very largely used on account of its intrinsic merits [*ante*, p. 325]; but a method of cooking that requires only the services of one form of fuel for oven and hot plate, or boiling, uses, and can give efficient service cheaply, including the heating of the kitchen and the boiling of water in bulk, is the one that must appeal to the masses. Price for all heat-requiring operations is not a negligible factor. Nor will we argue with him now as to how much or how little electric heating for the intermittent warming of rooms will become permanent, in the face of a much cheaper labour-saving method, which can, even before the gas-production developments just indicated have been established generally, be run freely by people of quite moderate means. We look forward to considerable changes in this connection. Mr. Wordingham, however, does not believe that electric heating will be employed for steady all-day heating, or for boiling the large quantities of water required for domestic and trade purposes, because "it will never be cheap or economical to do so." That is a very wise recognition of realities, which can be recommended to certain superficial surveyors of the relative positions of gas and electricity. We can excuse the feeling of a professional electrician that will not allow him to wholly abandon his own particular production as useless for any purpose, even though he has to admit that it is not economical for continuous employment, and therefore (proportionately) cannot be for intermittent service. At the same time, we can also admire the electrical engineer of such catholic view who goes even so far as to say that "this heating will probably be done to a large extent in the smaller houses by gas or by some solid fuel produced in the gasification of coal." But for large establishments, blocks of offices, and so forth, he believes that central heating is the coming thing. If the gas industry had only such broad-minded electrical men as Mr. Wordingham with whom always to deal, there might be very many more serious discussions as to mutual developments than there are at the present time. Nevertheless, we are satisfied as to the developments that are taking place within the gas industry, and the evident tendency to serving fuel economy by the promotion of closer relationships.

Electro-Culture and Fertilizers.

There is much grumbling in the electricity supply industry over what is regarded as the wearisome slowness of getting to work to prove in a scientific manner that use of a high-pressure electric discharge above a cultivated area has the effect of increasing production by 20 to 50 p.ct., according to the character of the crop, the soil, and the nature of the application. At some dozen places or so in the country, small experiments have been proceeding; and, though little has been yet allowed to transpire as to the results, sufficient has been divulged to show that the term electro-culture requires considerable modification, and a modification that will put to rest any fears of the producers of artificial fertilizers that their business is coming to an end. The truth is that the application of the electric discharge intensifies the greed of the plant and root growths for more moisture and nutriment in the shape of soil-applied fertilizers—the soil, one report says, must be "heavily" manured. Therefore electro-culture at best is only an auxiliary to artificial fertilizers, and not by any means a substitute. Whether the increased production of food stuff is worth the outlay to provide electric intensification (which need only be applied during cloudy weather, and when the sun is not shining), and the extra nitrogenous material, is a point for determination. At one time, it was supposed that the electric discharge split up the ions of the atmosphere, and enabled the plant growth to extract the nitrogen; but now students say this is secondary to the stimulation of the appetites of the plants and roots (as previously remarked) for moisture and the fertilizing properties incorporated with the soil. Weight of yield is not the only point about which information is required. The plant physiologist must tell us what is the effect upon the quality of the results. At the present time, the application of the current is haphazard and unscientific; and the electrical industry is crying out for a proper tribunal to investigate the matter, and one properly financed. It does not appear to be altogether satisfied with the Imperial College of Science. It wants a go-ahead body on the work; and if there is really anything in it—financially and qualitatively—sulphate of ammonia will welcome electricity as a coadjutor. One reason why the electricity industry requires this matter pushed forward is that it hopes simultaneously to obtain good business in electric power for running agricultural machinery, and incidentally perhaps for putting electric lamps in hen-houses so as to deceive the hens as to rising time, and thereby get them to commence egg-producing operations a bit earlier, and increase the yield in the sum total. When the fraud is discovered by the hens, the trade union principle as to lower production within a specified number of hours may be adopted in the hen-house.

The Dishonesty of It.

The maxim that we should help to bear one another's burdens does not apply generally to the requirements of everyday life. One cannot expect his neighbours to share the burden of his butcher's, baker's, grocer's, or any other bill; and the same thing should apply to electricity. Where private enterprise is responsible for the sale of lighting, power, and heating agents, there is no provision for a rate-in-aid if undercharging produces a deficit. The immoral practice, however, is gaining ground among local authorities during this war time, when individual responsibilities are in all conscience heavy enough, of charging electricity consumers under the cost of rendering them the service, and compelling ratepayers to make up the difference. The custom, indeed, is becoming so common that local authorities unblushingly make announcement of their intention, as though they were doing something virtuous. Gillingham is a case in point. The Electricity Committee are faced with a deficit, and took the proper course of recommending the Council to increase the charges by 10 per cent. The Council preferred having recourse to the rates, and rejected the proposal. Beckenham and Hastings are other instances to which reference has been lately made. It is time the Local Government Board were invested with power to compel proper trading methods, and not simply find themselves impotent beyond a suggestion that prices should be increased in order to meet deficits, and have the suggestion thrown contemptuously back in their faces by the local authorities concerned.

Assigned and Actual Efficiencies of Metallic Filament Lamps.

There has been interest in reading in the "Electrician" the specification issued by the Swiss Union of Electricity Works, for evaluating metallic filament lamps. The specification arrests notice for its admissions as well as for its proposals. Mean horizontal illuminating power is discarded, in view of the fact that in recent years electric lamps have come upon the market which do not give a fairly uniform distribution of light on the horizontal plane, and the emission in other directions varies so greatly that mean horizontal candle power no longer gives the correct impression as to the total light yielded by the lamps. So the specification proposes mean spherical candle power. It is said that for lamps with straight vertical filaments, the mean horizontal candle power is approximately 1·2 times the mean spherical candle power. Thus a lamp rated at 24 candles on the old system of measurement will have a candle power of 20 on the new system of rating. The life of a lamp is reckoned to continue good so long as its candle power is not diminished by more than 20 p.ct.—that is to say, it may lose one-fifth of its original illuminating power before it is regarded as being in a condition at which, for economy's sake, its services should be dispensed with. This brings us to the question of efficiency. The specification deals with two types of metallic lamps—"A" with an ascribed useful life of 800 hours, and "B" with 1600 hours' useful life. It is usually claimed by those electricians who do not know any better that the efficiency is 1 watt per British candle power; but it has been shown over and over again that the statement is a fraudulent representation. Let us take from the tabulated statement in the specification, for illustration purposes, the figures relating to 30-watt lamps. With a voltage of 100 to 139, the "A" lamps give 25·5 Hefner units (mean spherical value); "B," 21·5. At from 140 to 199 volts, "A," 25 Hefner units; "B," 20·5. At 200 to 250 volts, "A," 24·5 Hefner units; "B," 19. Voltages at home are usually within the range of 200 to 250; so that the "A" type lamps on that voltage (taking the tabulated figures) only give 0·816 Hefner unit per watt, and the "B" type, 0·633. The Hefner unit is only equal to 0·9 c.p.! This is not a confirmation of the 1 watt per candle power representation; and with the gradual decline to 20 p.ct. below the initial candle power, the efficiency is still further removed from the original pretensions. We will not go into the details of the specification; but it is noticed that the mean spherical candle power, as determined by test, must not vary by more than 15 p.ct. from the data given in the table from which we have quoted. For the gas-filled lamps, only a useful life of 800 hours is proposed, which also tells a tale of heavy renewal expenses.

GAS AND MOTOR FUEL PRODUCTION COMBINED.

UNDER this heading, there appeared in the "JOURNAL" for Sept. 4 (p. 420) an abstract of a paper, on the "Thermal Decomposition of Hydrocarbons," as submitted to the American Gas Institute by Mr. E. H. Leslie. A criticism of the points advanced is made in the "American Gas Institute News" for this month, from which some extracts may be given.

Mr. R. C. Downing, of Chicago, lays emphasis on the truth of Mr. Leslie's statement that the thermal decomposition of hydrocarbons is of the utmost importance to the gas manufacturer; and a thorough understanding of just what takes place inside the retort, the coke-oven, or the carburettor of a gas-machine is, he considers, a great aid in increasing the plant production and in controlling the quality of the gas sent out. Again, the paper is an excellent summary of the investigations made by various authorities on the subject of the thermal decomposition of oils, and so is of help in determining some of the research problems which may be undertaken by the gas chemist to gain his end of increased plant efficiency.

Mr. Downing continues: But even with the mass of chemical data at our disposal, it is still a difficult problem to know how to apply this information in order to obtain the maximum efficiency toward which we are striving. It is my belief that this problem can best be solved by preliminary experiments made on a small scale. The oil should be carburetted, or the coal carbonized, under varying conditions. Then the conditions which are found most favourable to possible improvements in manufacture should be duplicated in the works—preferably a small part of the works, from which the gas made can be isolated, measured, and tested. Conclusions drawn from such tests will not be liable to error.

I have spent considerable time in the past investigating the thermal decomposition of oils, mainly from the gas manufacturer's standpoint. The relative qualities or values of various types of oils can be most readily approximated by means of a laboratory cracking test. Further study of the reactions which occur under varying factors—such as temperature, time of contact, concentration, intimacy of contact, and nature of carburetting surfaces—were also studied. The conclusions I have reached were on the whole in accordance with those stated in the paper.

Mr. Leslie has discussed the reactions of the hydrocarbons, methane, ethane, and ethylene. My own observations have led me to believe that the following relations exist between them. When a gas-oil enters the carburettor of a machine it immediately decomposes into the higher molecular weight olefines, which constitute the greater portion of the tar, into lower molecular weight olefines, such as propylene and ethylene, into the saturated hydrocarbons ethane and methane, and finally into hydrogen and carbon. The prevailing temperature of the machine favours the preservation of the methane; but there is a tendency for the ethylene or propylene to be hydrogenated, with the formation of ethane and methane. Where oils were cracked in atmospheres of gases other than blue gases, the following facts were noted: When hydrogen is not present primarily—*i.e.*, when the decomposition occurs in an inert atmosphere, such as nitrogen or ethylene—but is formed as a primary decomposition product, it breaks-down into methane and hydrogen. When hydrogen was present in the cracking chamber, it showed a tendency to hydrogenate the ethylene to ethane. Further action of heat, in the presence of ample supplies of hydrogen, results in the hydrogenation of the ethane to methane, or the immediate formation of methane from ethylene. The most efficient utilization of oil occurs when the ethylene is not decomposed to too great an extent. This will be indicated by a comparatively low methane content and the presence of ethane, as shown by the gas analysis.

The conclusions I have reached concerning the effect of the concentration of the hydrogen present are also similar to those advanced by Mr. Leslie. As the concentration of hydrogen increased, the ethane and methane increased to a marked extent at the temperatures investigated—1250° to 1400° Fahr. The volume of illuminants produced per gallon of oil did not increase, but rather decreased. Less tar was also produced; and the apparent conclusion is that the hydrogenation of illuminants occurs more extensively in atmospheres rich in hydrogen. The same oil cracked in atmospheres of carbon dioxide, carbon monoxide, and methane produced no ethane, and less methane per gallon of oil decomposed.

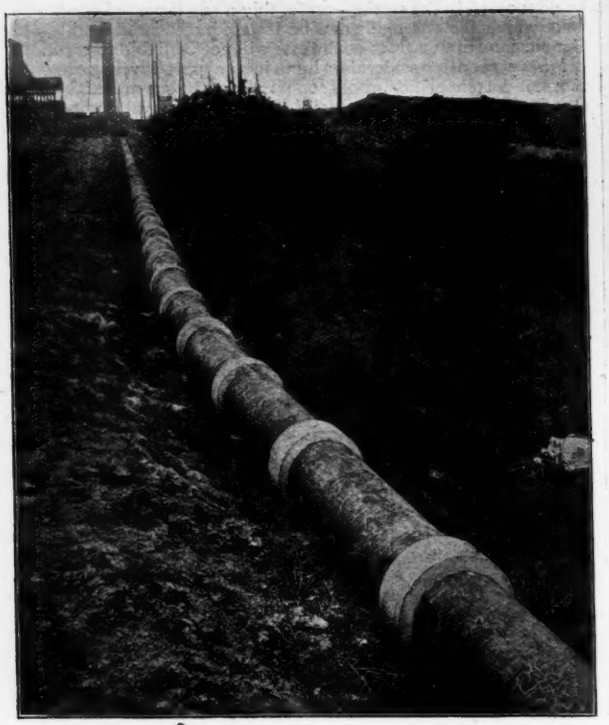
Mr. Leslie has also touched upon the question of the formation of aromatic hydrocarbons. This is of great importance, now that carburetted water gas is being scrubbed for light oils. Candle-power bears a close relation to the volume of aromatic vapours in the gas; and it is safe to state that the conditions which give rise to maximum production will also be the best for aromatic hydrocarbon production. Temperatures approximating to 1300° Fahr., short times of contact, high concentrations of the oil vapours with respect to the blue gas, and slightly increased spacing of bricks—all have been proved to be beneficial to the maximum candle per gallon production, and should yield more light oil per 1000 c.ft. The nature of the oil used is also a factor. An oil which has been cracked for gasoline production, according to Egloff, will not yield as much light oil as one that has not been cracked. Therefore, a paraffin base oil will be most favourable to aromatic production, with perhaps the exception of naphthene base oils which contain the closed chain before decomposition occurs.

As to the effects of the catalytic action of fire-brick, of iron, and of carbon. When I first began to work with oils, I desired to know if it was proper to crack in an iron pipe. To determine this point, an iron pipe was coated on the interior with a layer of fire-clay about ⅛ in. thick; and, after a few preliminary tests to insure the saturation of the brick, an accurate test was made. The same oil was then cracked in an iron pipe of the same inside dimensions, under exactly the same conditions. But little difference was noted in the results. Carbon coats the surface of any material used, and the catalytic action is destroyed.

Yorkshire Junior Gas Association.—The annual meeting of the Association will take place next Saturday afternoon, at Leeds University, when an Informal Address will be delivered by Mr. W. D. Helps (Managing-Director of Messrs. Milne & Son, Ltd.). The report and accounts will be considered, and officers elected for the coming session; and after the meeting the members will be the guests of Mr. Helps at tea.

REINFORCED CONCRETE GAS-MAINS.

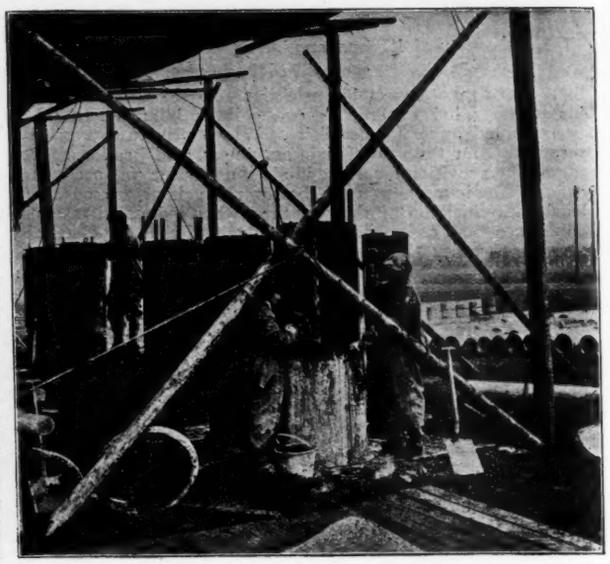
THE November issue of "Concrete and Constructional Engineering"—a monthly journal for engineers and contractors, and all interested in reinforced concrete, fire-resisting construction, and structural steel—contains a reference to the above subject, to which the Editor prefaces this note: In the following article



Fourteen-Inch Diameter Concrete Gas-Main for the Barnsley Smokeless Fuel Company.

particulars are given of what appears to be a new development of reinforced concrete—namely, its application to gas-mains. All concerned in the particular subject will, no doubt, watch this new experiment with considerable interest.

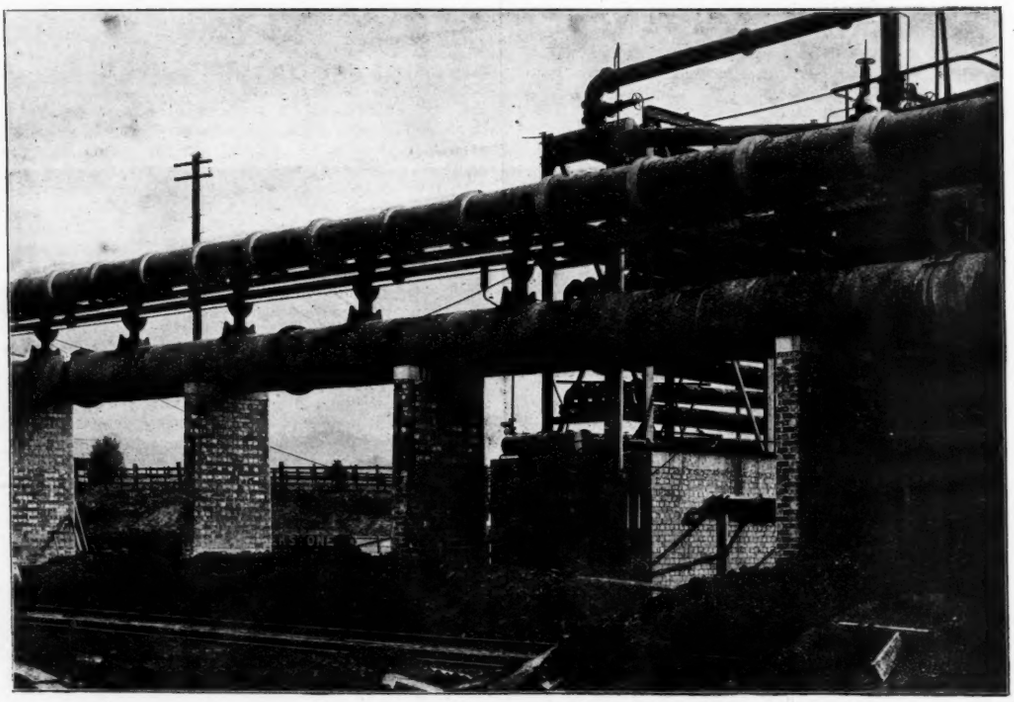
Our contemporary writes: The high cost of steel and cast-iron



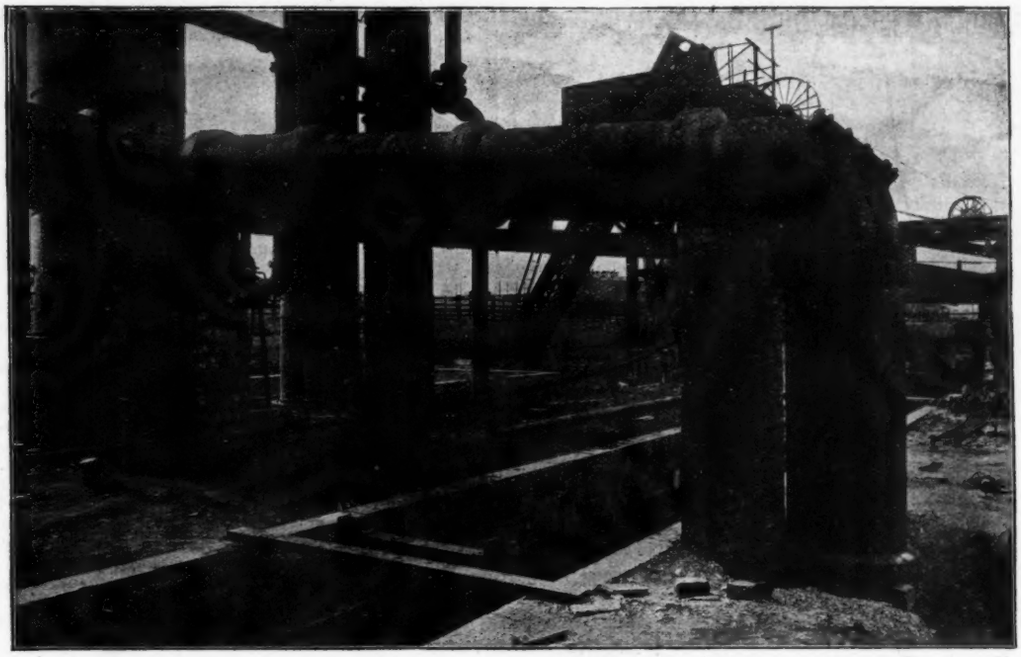
Women Concreting the Pipes.

mains, which hitherto have been exclusively used for the transmission of gas, has rendered it advisable (and even imperative) to have recourse to other materials and methods of construction. Reinforced concrete, having been largely used for water-mains, naturally presented itself as a possible substitute. Up till now—although gas engineers and specialists in reinforced concrete work have frequently admitted the possibility of using reinforced concrete pipes for the distribution of gas—they have been reluctant to commit themselves to the experiment. The principal difficulties which had to be overcome were the porosity of the concrete, and the difficulty of finding a suitable gas-tight joint. It is therefore to the credit of Messrs. Edmond Coignet, Ltd., the well-known reinforced concrete specialists, and to their clients, the Barnsley Smokeless Fuel Co., Ltd., that they have acted as pioneers in this matter; the former Company having designed, while the Barnsley Company have constructed, the first reinforced concrete gas-main in this country at the latter's new works at Barugh, Yorkshire. The gas-mains were designed and constructed in accordance with the general indications and requirements of Mr. Stephen Wellington, A.M.I.E.E., F.C.S., the Consulting Engineer of the new works; and it is mainly due to his enterprise that reinforced concrete was adopted.

The first question that presented itself was whether it would be preferable to make the pipes on the site of the works or in some particular spot away from the works, whence they would



REINFORCED CONCRETE ELEVATED GAS-MAINS FOR THE BARNSLEY SMOKELESS FUEL COMPANY.



A TWENTY-FOUR INCH CONCRETE GAS-MAIN—SHOWING BEND IN CAST-IRON, WITH MANHOLE.

ultimately have to be transported. On careful consideration, it proved more convenient to deliver all the materials and the moulds for making the pipes on the actual site of the works, where there was plenty of space available—more especially as the difficulties of transport were considerable. After investigation, it was found that the most suitable length to make the pipes for this purpose was 6 ft.; their diameters being respectively 14 in. internal and 24 in. external diameter. The smaller pipes have a thickness of only 1¾ in., and the larger ones of 2 in.; and they are reinforced by means of a meshwork of expanded metal. Special steel collapsible moulds were devised for the purpose of making the pipes on the site; and this method has turned out both rapid and practical. The collars for the joints between consecutive pipes were also made in reinforced concrete in a similar manner to the pipes, and in small moulds made for the purpose.

Practically, the whole of the operations of concreting these pipes has been carried out by women. The concrete was suitably graded, and of a proper mixture to ensure both strength and density; and the pipes were very carefully made, in order to prevent all possibility of air bubbles or cavities. After they were cast and matured, they were plunged in a bath of tar of a sufficient temperature to make it thoroughly liquid; so that the pipes should be permeated in every pore by this substance. This extra precaution was for the purpose of filling-up any small cavity or pinhole which might have remained undetected. The pipes were then laid in the trench in the same manner as cast-iron mains; and their ends were jointed by means first of a special joint of tow treated with pitch and cement.

Obviously, the success of making and laying pipes of this description requires that particular attention should be given to a number of important details, both in the construction and in the laying and jointing of the pipes.

From the point of view of economy, the advantage of reinforced concrete over cast-iron mains is very considerable.

Messrs. Edmond Coignet, Ltd., express the hope that this new application of reinforced concrete will be found as economical and practical after the war is over, and that a new industry for reinforced concrete will thereby be created.

SCOTTISH JUNIOR GAS ASSOCIATION.

(EASTERN DISTRICT.)

Visit to the Cowdenbeath Gas-Works.

Last Saturday afternoon the members of the Association paid their second visit to the Cowdenbeath Gas-Works. A party of about thirty availed themselves of the opportunity; and a very pleasant and instructive afternoon was spent.

The Cowdenbeath Gas-Works were fully described in the "JOURNAL" on the occasion of the Association's last visit, about five years ago. At that time it was stated that the works were built on modern lines, and for their size had a most complete plant for the handling of the coal and coke. In every way the Company are a go-ahead concern. Since the last visit the demands for gas in the area of supply have increased to such an extent that considerable extensions and enlargements of the gas-making plant were necessary; and the major portion of these have now been accomplished.

The extensions comprise a new retort-house, added to the original house, containing a bench of four ovens of eight retorts, built by the Standard Furnace and Setting Company; while a new steam boiler, 30 ft. by 8 ft., is also housed in the retort-house adjoining the bench. Each bench is fitted with its own gas and tar off-take into a collecting main; while the gas off-take from the old bench is coupled to the new one, so that the whole of the retorts are under the control of a retort-house governor. Another exhauster of 50,000 c.ft. an hour capacity has been put down as a stand-by, with a Holmes scrubber, of a capacity of 500,000 c.ft. per twenty-four hours, a set of four dry lute purifiers, fitted with a Weck's centre valve, a new house containing a new station meter of 20,000 c.ft. per hour capacity and a new station governor, and an enlargement of the sulphate of ammonia plant from 10 C.H. to 30 C.H. per day. These extensions bring the works up to a capacity of 100 million c.ft. per annum, which will be sufficient to serve the district for a few years to come.

In the distributing area, an important extension of the high-pressure supply to Aberdour opens up a field of great promise, owing to its close proximity to Rosyth. This was fully described by Mr. J. B. Scott in his Presidential Address to the North British Association of Gas Managers two years ago.

TEA AND A PRESENTATION.

Mr. J. B. SCOTT, the Engineer to the Cowdenbeath Gas Company, invited the members to Dick's Tea Rooms, to partake of tea.

After tea, in the absence of Mr. Hutton, the Chairman of the Company, Mr. SCOTT, in the name of the Directors, welcomed the members of the Association to Cowdenbeath.

The PRESIDENT, on behalf of the members, thanked the Directors for their hospitality. He then called on Mr. Waddell, the Engineer and Manager of the Dunfermline Gas-Works (an honorary member of the Association) to perform a very pleasant duty—to present Mr. R. Scott, the late Hon. Secretary and Treasurer, with a gold badge, to mark the appreciation of the Association for his services as Secretary for two years.

Mr. R. SCOTT suitably replied.

Mr. D. CAMPBELL (Kinross) intimated that the Council had agreed to invite Mr. J. B. Scott to become an honorary member of the Association.

Mr. SCOTT accepted the invitation, and expressed his thanks.

London and Southern District Junior Gas Association.—Though circumstances render it impossible for the Association to maintain at present their pre-war activities, the Hon. Secretary (Mr. George Winslow) states that they are determined to do all that is possible to keep the remaining members in touch. To this end, two meetings will probably be arranged during the present session. One of these will be on Jan. 11, at the Westminster Technical Institute, when Mr. W. Newton Booth, of the Royal Arsenal Gas-Works, Woolwich, will read a paper on "Some War-Time Lessons for the Gas Industry." The officers and Council of the Association remain as hitherto, except that Mr. F. A. Frost has been elected Junior Vice-President in place of Mr. F. C. Briggs who has gone to Dudley.

SOME NOTES ON BENZOL RECOVERY.

An address dealing with "Some Notes on Benzol Recovery" was given by Mr. A. PERCY HOSKINS, F.I.C., F.C.S., at a meeting of the Belfast Association of Engineers last Thursday, in the Central Hall of the Belfast Municipal Technical Institute. Mr. A. M'I. Cleland (the President) occupied the chair, and there was a good attendance.

After giving an interesting description of benzol and its uses, Mr. Hoskins proceeded to describe the various sources from which it is derived, emphasizing the importance of coal distillation in this particular. A comparison which followed of the past and present relative positions of the United Kingdom and Germany as regards benzol recovery and utilization proved most interesting. It showed not only the opportunities that we have thrown away, but also those which are still at our command. The wastefulness of burning raw coal was insisted upon. The distillation of coal tar for benzol was next referred to, and the extraction and recovery of benzol from coal gas by the most modern methods was explained. In conclusion, Mr. Hoskins offered some thoughts on the future possibilities in the utilization of benzol, and expressed his indebtedness to the Technical Press—mentioning in particular the "GAS JOURNAL" and the "Journal of the Society of Chemical Industry"—for much of the material incorporated in the address.

A very interesting discussion followed, to which Mr. Hoskins replied. A cordial vote of thanks was passed to Mr. Hoskins for his communication.

RECOVERY OF TOLUOL FROM GAS-WORKS.

Report by Sub-Committee of the American Gas Institute.

Advanced proofs have reached us of a condensed report, as it will appear in the next issue of the "American Gas Institute News," on the "Recovery of Toluol from Gas-Works," prepared by the Sub-Committee on Coal-Tar Bye-Products for the Committee on Chemicals.

In presenting the report, the Chairman of the Sub-Committee (Mr. W. H. Childs) calls attention to the fact that, in the description of processes, there has been given a practical method of toluol recovery that has been in successful operation for several years; but the Committee do not wish to be understood as saying that it is the best possible in all details. The recommendation which they make is that—"If, on statement of the facts and estimates as herein set forth, the Government needs the toluol, the Committee suggest one way of accomplishing this object to be that contracts should be made by the Government with the respective gas companies for the full production of at least one year, allowing in the price sufficient amount to amortize the cost of such plants. This cost cannot now be accurately determined, for reasons set forth in the report, and would rest largely upon the action of the Government in determining the price for the steel, castings, pipes, &c. Further, so as to facilitate the necessary financing, the Government should be willing to advance the money for amortization during the construction period." A number of questions were submitted by Major J. T. Crabbs (U.S. Army, ret.) to the Sub-Committee, and these they deal with.

QUANTITY OBTAINABLE.

The first had relation to the quantity obtainable; and to ascertain this, a circular was sent out to some 75 of the largest gas companies. The estimate given is based on 1·6 p.ct. of gas oil used in water-gas manufacture, and 0·03 gallon per 1000 c.ft. of coal gas. The Sub-Committee have not included any plant that will produce less than 10,000 gallons of pure toluol per annum; and they recommend that such plants should not be considered until the Government show a desire to get more toluol than can be produced by the companies enumerated. Not included in the companies here dealt with, and excluding also the gas companies supplied with oven-gas from which the light oil has already been removed, there are some 800 other companies that will manufacture in the aggregate during 1918 coal gas and water gas equivalent to 3,300,000 gallons additional toluol from all companies.

Total Recovery of Toluol from Gas-Works as Contemplated in the Report.

	Gallons.
Gas-works recovering toluol prior to Aug. 1, 1917 . .	1,733,718
Gas-works recovering toluol or erecting recovery plants between Aug. 1 and Sept. 16, 1917	1,224,000
Gas-works as shown in the report not started on toluol recovery	6,139,000
Total	9,096,718

DESCRIPTION OF PROCESS.

In describing the apparatus recommended for the recovery of toluol, the Sub-Committee divide their remarks into two parts—(*a*) the process of removing the light oil from the gas, stripping the light oil from the wash-oil, and fractionating the light oil; and (*b*) refining the toluol fraction of the light oil.

Apparatus for Making from 40 to 65 Gallons of Light Oil per Hour.

They give a full illustrated account of apparatus suitable for plants making up to 40 to 65 gallons of light oil per hour, and of the operations up to the point where the separation and collection take place in liquid form of the light oils from the wash-oil, and the returning of the debenzolized wash-oil to the gas-scrubbers. Whether in works sending out less than an average of 750,000 c.ft. of gas per day it will be best to stop the toluol recovery process at this point and sell the light oil so separated to the benzol and toluol refining companies for refining into pure toluol and pure benzol, or for the gas company to continue to the next stage of separating the crude benzol fraction from the crude toluol fraction, sending only the toluol fraction to be refined, will depend upon various factors.

If, they say, it is desired to separate the solvent naphtha from the heavy naphtha left in the still, and small quantities of wash-oil carried over, live steam is continually admitted into the body of the oil through a perforated pipe running along the bottom of the still. By this means, the solvent naphtha will be driven off rapidly. The residue may be returned to the debenzolized oil tank. The different fractions are condensed in a worm condenser, any remaining water is removed by the separator, and the benzol is run into the crude benzol storage tank, the crude toluol into the crude toluol storage tank, and the solvent and heavy naphthas are collected either in one or two tanks as desired. The benzol fraction thus obtained will contain about 85 p.ct. of pure benzol and olefines; the balance being toluol and solvent naphtha. The toluol fraction will contain from 60 to 80 p.ct. of toluol; the balance being a little benzol, olefines, and solvent naphtha. The benzol fraction can then be pumped back into the gas for enrichment, or can be carried on to the fourth stage where the refining of these oils begins. If used for enrichment, it should be examined to see if the sulphur content will stain the acetate of lead paper used in testing gas. If the benzol is introduced beyond the purifier-outlet, it may be necessary to introduce it into the gas at the purifier-inlet.

In water gas, the total amount of toluol will be very close to 2 p.ct. of the gas oil used. If the entire light oil is sent to a refining plant, and the refining plant has an efficiency of 90 p.ct. in toluol recovery, one might expect to get 1·8 p.ct. of the gas oil used as saleable pure toluol. If the benzol fraction is replaced in the gas, and only the toluol fraction is sent to the refinery, there will be a loss of total toluol due to that contained in the benzol fraction and in the naphtha fraction of as much in practice as 10 p.ct.; so that the toluol sent to the refinery will amount to only 1·8 p.ct. of the gas oil used. Assuming now an efficiency of 90 p.ct. in the refining plant, the amount of pure toluol recovered for sale will be 1·6 p.ct. of the gas oil used. The amount of toluol recovered from coal gas will be found to be somewhere about 0·03 gallon per 1000 c.ft.

The steam pressure, as shown by a gauge in the still-house, should not be allowed to get below 100 lbs.; and water should be supplied at a uniform pressure. The amount of steam required to strip the light oil from the wash-oil is estimated at 1·3 H.P. per gallon of light oil per hour.

Tank for Cumarone Jelly and Naphthalene.

There is extracted with the oils from the gas a jelly-like material, which will remain with the wash-oil, and which, if not removed, will cause the oil to become so heavy as to make it unfit for use. It is advisable to provide an open tank, water cooled, into which a certain portion of the wash-oil can be placed each day, to allow this jelly and naphthalene to settle-out. The clear oil can be drawn from the top and returned to the debenzolized oil tank; the jelly being scraped out and discarded.

Scrubbers for Plants Making more than 65 Gallons of Light Oil per Hour.

There should be two scrubbers in tandem for plants producing more than 65 gallons of light oil per hour. Estimating on a basis of total scrubber capacity of 30 c.ft. per 1000 c.ft. of gas per hour it is advisable to use two scrubbers, since in many cases there would otherwise be too great a weight per square foot of foundation, without unusual expense. It is even advisable, for efficiency in scrubbing, to have two scrubbers for smaller plants, though not entirely necessary.

Plants Making from 15 to 40 Gallons of Light Oil per Hour.

Explaining a plan for the recovery of toluol and isolating the toluol fraction, the Sub-Committee remark that the maximum amount of light oil produced will probably be not over 0·5 gallon per 1000 c.ft. of gas. In a plant of 75,000 c.ft. per hour, this would amount to 37½ gallons of light oil per hour, or 900 gallons per day. Estimating the amount of wash-oil introduced into the scrubber per 1000 c.ft. of gas at 15 gallons, the total amount of wash-oil per day would be $75 \times 15 \times 24 = 27{,}000$ gallons.

By increasing the size of the debenzolized wash-oil tank, the benzolized oil tank, and the column, so that the entire amount of benzolized oil that comes from the scrubber in 24 hours can be distilled through the column in 16 hours, it will permit the same column to be used for at least six hours each day for fractionating the light oil, thereby saving the expense of installation of another

column and the necessary building, less the cost of extra size of tank and column.

The debenzolized wash oil-tank must hold at the time that the column is changed from the stripping to the fractionating process enough wash-oil to permit the scrubbing of the gas to go on continuously during the time that the column is used for fractionating. That is, $75 \times 15 \times 8 = 9000$ gallons of wash-oil. And the benzolized oil-tank must hold a similar amount, since nothing can be pumped from it into the column during the eight-hour period. Allowing 1000 gallons extra, it would make these two tanks have a capacity of 10,000 gallons each.

The selection of 15 gallons of light oil per hour as a minimum production for which the apparatus they describe is recommended is purely an arbitrary figure; the thought being that in some works making less than 15 gallons of light oil per hour and others making more than 15 gallons, the location with respect to some other plant might be such as would justify them in sending their light oil to be distilled at a larger plant, and doubling-up with some other gas-works fairly close in the fractionating operation.

The amount of light oil that would be produced in a plant making 1,000,000 c.ft. of gas per day will not be over 500 gallons

Chemical Control of Recovery Plants.

After dealing at length with the refining of the toluol fraction of the light oil, reference is made to the chemical control of recovery plants, in which connection a description is given of apparatus used to value the hydrocarbons by the distillation test. Details are also given of parts of scrubbing and fractionating plants.

Loss of Candle Power and Heating Value of Water Gas.

The following are figures with regard to the loss of candle power and heating value of water gas by the extraction of light oil:

	Candles.
For every gallon of oil used there may be extracted 1-10th of a gallon of light oil.	
The illuminating value given to 1000 c.ft. of gas by 1 gallon of gas oil will average approximately	5·75
The illuminating value lost by the extraction of 1-10th of a gallon of light oil is	2·86
Remaining candle power after extraction of light oil . .	2·89
If the crude benzol fraction containing olefines is returned to the gas, the candle power restored will be . . .	0·91
Candle power of gas sent out.	3·80

Or 66 p.ct. of the original candle power.

The average oil used per 1000 c.ft. by gas companies, from which they propose to recover toluol is 3·8 gallons. Estimating a loss of 1·95 candles per gallon, the average loss in candle power will be 7·4 candles. Similarly, the average loss in heating value will be about 27 B.Th.U., or a loss of about 5 p.ct. of its heating value. With the exception of some of the larger gas companies operating on a high candle-power basis, it would be physically possible to restore the gas to the present established standard of quality by the use of more gas oil per 1000 c.ft. To restore the 27 B.Th.U. per 1000 c.ft., it would be necessary to add not less than 0·26 gallon of oil.

The Scrubber Oil to be Used.

The Sub-Committee say that the wash-oil to be used, if straw oil,* should be of about the following specification:

1.—The gravity at 60° Fahr. shall be not less than 34° Bé.
2.—The flash-point, open cup, shall be not less than 275° Fahr.
3.—The viscosity in the Saybolt viscosimeter at 100° Fahr. shall be not more than 70 seconds.
4.—The pour-test shall be not over 30° Fahr.
5.—When 500 c.c. of the oil are distilled with steam at atmospheric pressure collecting 500 c.c. of condensed water, not over 5 c.c. of oil shall have distilled over.
6.—The oil remaining from the steam distillation shall be poured into a 500 c.c. cylinder, and shall not show any permanent emulsion.
7.—The oil shall not lose more than 10 p.ct. by volume in washing with 2½ times its volume of 100 p.ct. sulphuric acid. [The oil is vigorously agitated with the acid for five minutes, and allowed to stand for two hours.]

Care should be exercised in not allowing the smaller gas companies, not equipped with large laboratories, to use a quality of straw oil that will not readily separate from the light oil or emulsify with it, so that there shall not be an undue amount of wash-oil going forward with the light oil nor a loss in the scrubbing efficiency by reason of some of the light oil remaining with the debenzolized oil.

Steps should be taken at once to secure 1,000,000 gallons of such grade of oil, or a proper substitute should be secured ahead, because it is clear that there is not going to be a large excess of creosoting oil of the quality required.

Cost of Operation.

The cost of operation of the plants for separating the toluol fraction will be at a minimum in those large plants that are not required to restore the heating value or candle power standards by the use of additional gas oil, which, of course, should be charged to the cost of the toluol. Until the method that will be pursued in financing and operating these plants is fixed upon, it would appear to be idle to speak of the cost of recovery. This recovery, as now conducted in various plants, ranges from 25 c. to 75 c. per gallon of crude toluol, exclusive of amortization, interest on investment, or depreciation.

*NOTE.—The wash-oils now in use are so-called straw oil, sold through oil-refining companies, and oils having a specific gravity of about 1·04, obtained from the distillation of coal tar or water-gas tar and sold by the tar distilling companies. They must have the property of not starting to boil below 200° C., at which temperature the whole of the light oil will have been boiled off.

QUICK REVOLUTION GAS-ENGINES.

By V. E. GREEN, Assoc.M.Inst.C.E., A.M.I.M.E.

[A Paper read before the Midland Junior Gas Association, Nov. 15.]

This paper is intended to deal chiefly with the vertical type of quick revolution gas-engine, which is practically a British production. The rotational speeds of such engines vary from about 500 R.P.M. for a 50 B.H.P. size down to 250 R.P.M. for a 1500 B.H.P. size; these sizes being approximately the present limits of construction. The corresponding piston speeds would be about 850 ft. and 750 ft. per minute for the large and small sizes.

The upper limit of size at the present time seems to be fixed on account, for the sake of design simplicity, of doing away with the water-cooling of the pistons. Up to about 24 in. diameter, it is possible to run with an uncooled piston, and also to use one of the trunk type. Above this size, water-cooling becomes necessary, and it also seems advisable to use a piston-rod and crosshead, as is usual with steam-engine practice.

Generally, the type of engine being considered is run on the four-stroke cycle; the cylinders being single-acting. The working fuel may be either town's gas, suction or pressure producer gas, or the waste gas from blast-furnaces and coke-ovens. Little change in the design is necessary in order to run on either, or even on any kind of gas fuel.

From a constructional point of view, the outside appearance at any rate is similar to the well-known design of quick revolution steam-engine. The whole is arranged for forced lubrication, being entirely enclosed. The cylinder, or a set of tandem cylinders, is bolted direct to the top of the frame, which is, in turn, fixed to the bedplate or crankcase; this portion being fixed to the foundation. The cylinder, made with hard, close-grained cast-iron, usually has the jacket cast in one piece with the barrel; a flexible making-up joint being provided at the lower end. The cover is dished, and arranged for water-cooling, and in a good design is free from inlet and exhaust valves, and, in fact, any gear which would lengthen the time for withdrawing the pistons. The pockets containing the inlet and exhaust valves are placed at one side—this leading to a simple design of valve mechanism. The centre line of the cylinder is often placed in front of the axis of the crankshaft, reducing the angularity effect of the connecting rod on the explosion stroke, as well as minimizing the wear between the cylinder walls and the piston rings.

The frame to which the cylinders are bolted encloses the motion work and supports the cam-shaft, also providing means for fixing the indicating gear levers. The bed-plate supports the crankshaft with its bearings, and is generally made of a heavy box section, machined on the underside where fastened to the foundation-plate or block. It also contains the lubricating oil, with the necessary pumps and strainers, and receives the drip of the oil from the various bearings.

The crankshaft is machined from a solid forging of steel, of about 35 to 38 tons to the square inch tensile strength, and is arranged so as to have a bearing adjacent to each crank web. The bearing next to the fly-wheel is larger in diameter and longer than the other bearings, as at this point any bearing trouble first shows itself. The bearings consist of cast-iron shells, white-metal lined, and have very small clearances. For fixing the flywheel a flanged end is best, especially where questions of freight are serious; but the cost is somewhat greater, notably on the initial cost of the forging. When the engine is coupled to another shaft, the coupling bolts would pass through the engine half coupling and the flywheel nave, preventing any endwise movement of the wheel relative to the engine. The flywheel is generally of the cast-iron disc variety, being provided with holes or notches in the rim for barring-round purposes.

Considering the details of the motion work, the item which demands most attention in its design is the piston. This is of the trunk type; the relation between length and diameter being equal to about 1:5. The length is necessary to form a guide surface in place of the crosshead and slides, though, in the opinion of many designers. these would be better if fitted on large sizes. It is a good practice to anneal the piston castings after the rough machining, before finishing finally to size by grinding. This should also be done with the piston ring castings, as well as the cylinders if convenient. The piston is in many cases provided with a diaphragm or false top, to prevent the splash from the lubricating oil coming directly into contact with the heated piston crown. Ramsbottom type of piston rings are used in numbers of three and upwards, placed at the top end of the piston; while another one or two are placed at the lower end, to scrape off any surplus lubricating oil finding its way on to the cylinder walls.

The connecting rod is of the marine type at the crank-pin end; the small end in low-powered engines being often made solid, with no adjustment for wear. On the larger sizes, however, the gudgeon

pin end is split, allowing for wear to be taken up. To make the adjustment, it is necessary to take the gudgeon pin out of the piston, when the required screwing-up or closing-in can be accomplished. The gudgeon pin is then pushed through the piston, with the connecting rod end screwed up and in position. If much wear has taken place, it may be advisable to put a liner under the connecting rod foot, so as to keep the clearance volume the same. It may be worth while pointing out that the dimension of the crank-pin end of the rod is partly settled upon on account of the necessity of withdrawing the piston and connecting rod out through the top of the cylinder, as there is no room for taking them out through the engine frame or casing doors. This fact also has to be reckoned on when the engine room and crane height is being settled.

The cam-shaft is fixed horizontally in white-metal lined bearings carried by the engine frame, being rigidly proportioned, and in the four-stroke cycle engine runs at half the engine speed. The reduction gearing, after much experience, now usually consists of a pair of plain spur wheels having involute teeth; the pinion being of steel and the wheel of cast iron. When the engine-room space is limited, it is advisable to make the shaft in two pieces for ease in dismantling.

The various cams are forced on to the shaft as well as being keyed; the shaft being finally ground-up after this process. On account of the expanslon due to change of temperature, it is advisable to fix the shaft at one end only, to allow for longitudinal travel. This also applies to the crankshaft, which is provided with thrust collars at the flywheel end only. The cam shapes require careful thought, as upon them depend to a large extent the quiet and efficient running of the engine. In connection with this, it was announced that one firm utilized the kinematograph for studying the effect of various cam shapes, finding in some instances that the valve plunger rod ends were hitting the cam surfaces and bouncing off and on again through appreciable distances. In a modern works the cams are finished by grinding on a special machine, using a carefully drawn out cam on an enlarged scale as a forming template. The cams and all rollers and spindle ends are of case-hardened steel. Running clearances are left at the valve spindle tappets, so as to ensure the valves being right on their seats at the proper periods when the engine has warmed up. Adjustments are also usually allowed for taking up any excess clearance at these points due to wear. The sizes and travels of the inlet and exhaust valves are arranged so as to give velocities of about 120 ft. and 100 ft. per second respectively. The inlet valve also is designed to allow the exhaust valve to pass up through the inlet valve chamber. Either cast iron or low nickel steels are employed in the construction of the valves; while the seatings are made with hard cast iron, having chilled wearing surfaces.

It is now well recognized that the satisfactory continued running of quick revolution engines depends a great deal on the method of lubrication and its freedom from cessation due to any cause. The oil, of a mineral variety, is contained in the bed-plate to a depth sufficient to cover the oil strainers, and is pumped from there, by a valveless type of pump driven through an eccentric mounted on the crank-shaft or cam-shaft, to all the main working parts of the engine. The oil is first fed by pipes into the main crank-shaft bearings, conveyed through holes in the crank-shaft to the crank-pins; a portion being taken thence up the centre of the connecting rod, or through a pipe fixed to it for lubricating the gudgeon pins. The cam-shaft bearings are also forced lubricated, as well as the cam-rollers and guide sleeves.

The oil pressures used range from 10 lbs. to 20 lbs. per sq. in.; the pump capacity being about 0·1 gallon per minute per B.H.P. developed. This means the oil would be circulated once every three or four minutes; the temperature of the oil rising to about 150° Fahr. If this is exceeded, due to engine-room conditions, it is necessary to cool the oil by fitting water-cooling devices in the engine bedplate, or by taking the oil to an external cooler. The consumption of lubricating oil under good conditions is as low as 1½ gallons per twenty-four hours on a 400 B.H.P. engine. Under conditions of lengthy runs at full load, some oil vapour is formed in the crank chamber; and it is advisable to fit a ventilation pipe to take away the vapour and prevent any likelihood of explosion trouble.

The induction pipe of a multi-cylinder engine calls for careful design, so as to ensure each cylinder getting its proper supply of fuel. Both air and gas inlet pipes are fitted with cocks for hand regulation purposes, and for shutting-off the gas supply when the engine is not running. The supply of air is in many cases taken from outside the engine-room; the extreme end being fitted with a silencer to stop or diminish the whistling noise which would otherwise be produced. A cylindrical pipe-shaped casting with longitudinal slits, with its end turned down to exclude the rain, is quite satisfactory. Between the cocks mentioned above and the induction pipe, a governor valve for controlling the engine speed is fitted. This consists of two double-beat valves, fixed on the same spindle, controlling both gas and air supplies by means of throttling, or what is called "quantity" governing. This system provides for the full number of working strokes—*i.e.*, an explosion per cylinder every fourth stroke in the four-stroke cycle engine. The effect at light loads is to cause the suction line on the indicator diagram to fall below the atmospheric line, and thus alter the final compression pressure.

The travel of the throttle valve between overload and no load conditions is very small—say, about ¼ in. on a 400 B.H.P. engine. Consequently, the governor operating the valve has to be made very accurately; all pin joints and wearing parts being provided with case-hardened and ground surfaces, as well as supplied with oil from the forced lubrication system. The governor balls rotating in the vertical plane are spring controlled; an external spring being fitted for purposes of speed control by hand—a margin of 5 p.ct. above and below the normal agreeing with the general requirements.

The range of governor controlled speed usually obtained in practice is about 6 p.ct. momentary and 3 p.ct. permanent variation between full and no load conditions. The above limits are quite good enough for direct electrical driving, either on continuous or alternating current machines. It may be well to mention that slightly different types of governor throttle valves are used for running on town's gas or producer gases. The mixture of the gas and air supplies actually occurs in the cylinder, and the best means must be taken to get a good ignition instantly. On large cylinders, two sparking plugs are usually fitted—each one being connected to a separate ignition gear, consisting of a low-tension magneto with high-tension separate coil. An accumulator and change-over switch is also often fitted as a stand-by and for use at starting, though on some large engines only two magnetos are fitted and no battery equipment at all; the starting-up of the engines being satisfactory in every respect. In some cases the Lodge ignition gear is fitted; no magneto being used at all.

The modern starting arrangements of the quick revolution gas-engine, coupled with good ignition methods, leave little to be desired in satisfactorily overcoming any usual condition of starting torque—no clutches, half compression cams, or similar devices being necessary. Compressed air is almost invariably used at pressures between 250 lbs. and 300 lbs. per sq. in. The compression air from the receiver is taken to a valve which is operated by a cam on the half-speed shaft, and from there to a non-return valve communicating direct into the engine cylinders. It is only necessary to take the air to half the number of cylinders on the engine. The cam-operated valve is opened a few degrees later than the main gas-inlet valve on the same cylinder; and as the explosion pressure is greater than the air pressure used for starting, as soon as the first explosion takes place in the cylinder the compressed air supply is automatically cut off. Of course, when the engine is well started the supply is also cut off by hand. The compressed air receiver capacity is about 4 or 5 c.ft. of compressed air for a 400 B.H.P. engine; the compressor capacity being about 10 c.ft. of free air per minute—these figures being for an electrical generating station set, where only a few starts per day are necessary. In such a station the compressor could be electrically driven; but where no current is available, a small gas or petrol engine set would be used for the purpose.

The cooling water, which should be at 10 to 15 lbs. per sq. in. pressure, is first brought to the bottom of the cylinder jacket, rising upwards to the cylinder cover, and taken thence to the exhaust pipe jacket, and then direct to the waste or cooling pond. Jacketing the part of the exhaust pipe which is adjacent to the engine ensures a much cooler engine to work round and operate, and gives more satisfactory results than the method of spraying water into the exhaust pipe, with its tendency to form acids, which quickly corrode the pipe walls. It is a good plan to arrange for the water supply from each cylinder to be exposed at some place in the return; this enabling the attendant to see that the water is properly distributed. The temperature of the water leaving the engine should not exceed 140° Fahr., and, allowing for a rise from the inlet temperature of (say) 80° Fahr., will necessitate about 6 gallons of water per B.H.P. hour.

The pump for circulating the water is in some cases driven from the engine. But it will be seen that, as soon as the engine stops, the water remaining in the jackets will tend to boil away and cause any matter in solution or suspension to settle on the jacket walls. This would in time bring about trouble due to overheating, and might cause cracking. With the pump driven in the above manner, it would be perhaps best to supply the water to an elevated tank; leaving the valve in the pipe between the tank and the engine open for some time after shutting-down the engine. Separate pumps might be driven similar to the compressed air set, or even from a countershaft run from the same small engine or motor. As the operation of both the water pumping and compressed air sets is of extreme importance, in some cases a countershaft drive is arranged, with an additional small engine or motor as a stand-by.

It is the general practice on all sizes of these types of gas-engines to test them at various loads, including an overload which would be about 10 p.ct. above the full load. If the engine is to drive an electrical generator the proper machine would be coupled to it on the test bed; the electrical energy generated being dissipated in water resistances. In most other cases, a Froudes water-brake would be used; the impeller portion being coupled direct to the engine. After a few hours' preliminary running, when the indicator cards are examined for power distribution, compression pressures, &c., the proper tests are proceeded with. In carrying out these, readings are taken of the speed, power, gas consumption, calorific value of the gas, inlet and outlet water temperature, and oil temperature in the crank case; while various sets of indicator diagrams are obtained. A full-load test would last about six hours. After this, the overload test would be taken; this latter lasting for half-an-hour, which is the usual period of overload the engine is guaranteed to do.

From the results of many tests it is found that these engines

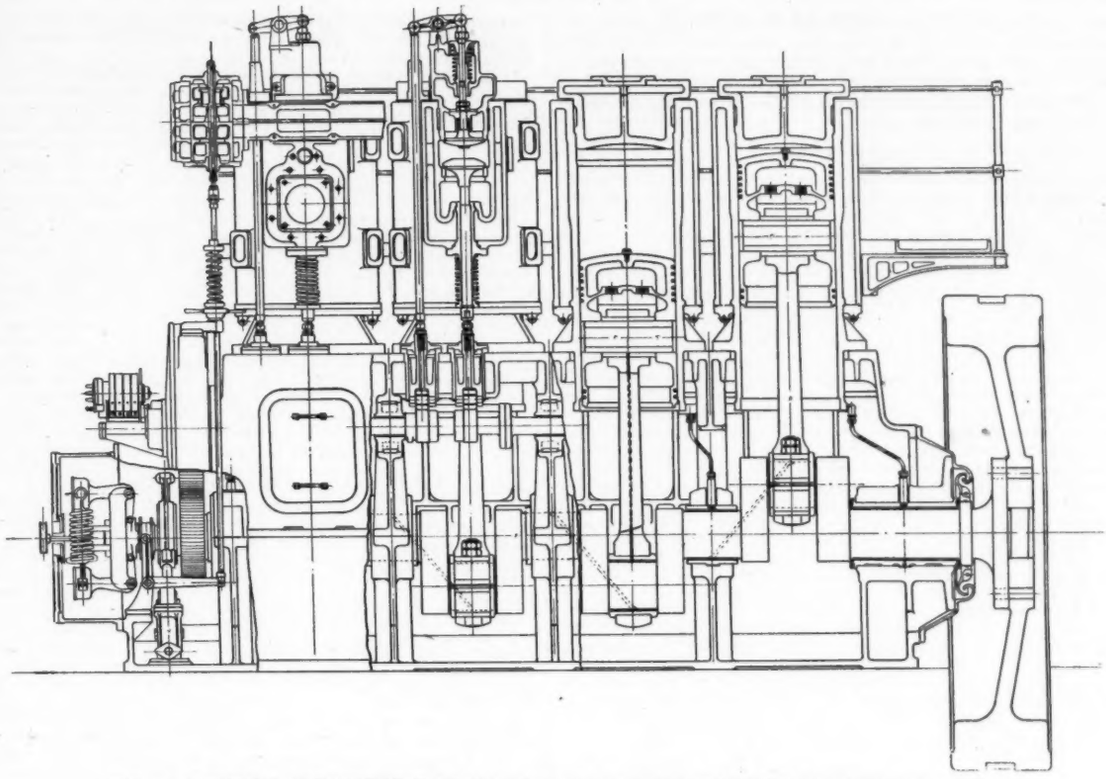


FIG. 1.—SECTIONAL ARRANGEMENT OF GAS-ENGINE BY MESSRS. BROWETT, LINDLEY, & CO., LTD.

require about 9500 B.Th.U. per B.H.P. hour, when running under full load with good conditions; the heat consumptions at half and quarter load being about 12,000 and 14,000 B.Th.U. respectively per B.H.P. hour. The mechanical efficiency at full load is between 80 and 85 p.ct. Possibly better figures than these may be obtained after the engine has been in commission a few months, when all the piston rings are bedded in and the valve-seats have good working faces. On sets of 300 B.H.P. and upwards, when working from a bituminous pressure producer plant, the coal consumption, including stand-by losses, would be about equal to 1¼ lbs. per B.H.P. hour.

Regarding the applications of quick revolution gas-engines, the need for the direct driving of electrical generating machinery, as in the case of the steam-engine of the same type, has brought about its present state of perfection. The greater number of the gas-engines in use to-day are direct-coupled to continuous or alternating current generators; no difficulty being experienced in parallel running—the four-crank engine being eminently suitable for this purpose. In some minds there will be a tendency to think that a three-crank engine would give better results from a turning moment point of view than the four-crank engine; but a little consideration will show, when the cycle of operations is looked into and the inertia effects considered, that the four-crank engine is undoubtedly the better one.

Although the driving of electrical machinery up to the present time has been the mainstay of the quick revolution gas-engine industry, its field of application has been continuously extended. These engines are now being used in connection with belt and rope drives, and for driving through reduction gearing, pumping machinery, or shop shafting; the convenience of being able to start against full load torque, with reliability and economy of running, ousting in many cases steam-driven machinery.

A use in which gas engineers may be shortly interested is for the direct coupling of these engines to reciprocating compressors for the compression of gas at high pressures for use with motor vehicles. The writer believes that a compressor, similar in construction to the "Reval" air compressors, and direct coupled to the gas-engine, would give excellent results. The system of mounting the gas compression cylinders tandem to the gas-engine cylinders does not seem to hold forth much promise.

Finally, it will be interesting to speculate as to the length of time before the maximum size of this vertical type of gas-engine is

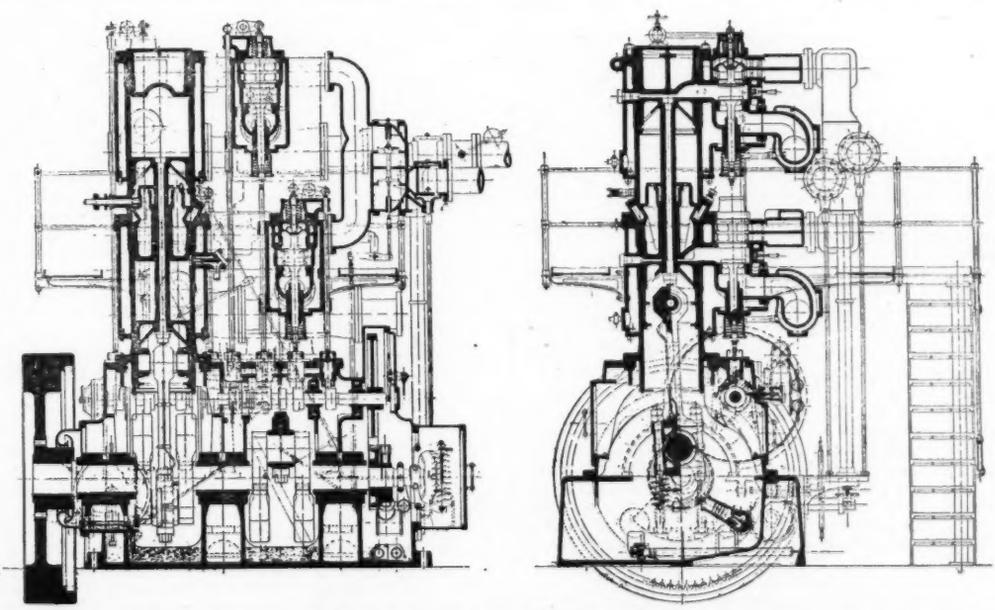


FIG. 2.—SECTIONAL ARRANGEMENT OF TANDEM GAS-ENGINE BY THE NATIONAL GAS-ENGINE COMPANY, LTD.

reached, and as to how soon afterwards it might be largely superseded by a turbine machine using the same working fluid, as in the similar case of the quick revolution steam-engine and steam-turbine. Let us hope, however, that in any case the gas-turbine, when it arrives in a practical form, will be a British production, as was the steam-turbine.

DISCUSSION.

The PRESIDENT (Mr. R. G. Marsh) pointed out that Mr. Green, who was a comparatively recent addition to the staff of the Birmingham Gas Department, was extremely well qualified to speak on the subject of the paper. His experiences had been of a varied character.

Mr. R. J. ROGERS (Birmingham), in moving a vote of thanks to the author, inquired as to the comparative cost of vertical quick-revolution gas-engines and horizontal engines, having regard to horse power. There was no doubt that, in the future, with the probable generation of electrical energy near to gas-works, the former type of engine would become more popular. It was a matter for surprise that gas engineers had not used vertical engines to a greater extent. From the point of view of working, they were entirely satisfactory; the cost of maintenance being low. During the period of the war, gas for industrial purposes had attained a satisfactory position; but he would like to have seen a still greater use of gas-engines. Difficulty in obtaining deliveries might have been an influencing factor; and he knew instances in which manufacturers had installed electrical motors because they could not get assurance of deliveries of gas-engines within a reasonable period. An important after-the-war question would be that of the use of gas for power purposes. Before the war there was keen competition between gas and electric supply undertakings in this branch of business; and the information given as to the capacity and effectiveness of quick-revolution gas-engines was of the utmost importance. He felt that considerable use might be made of the cinematograph in relation to the study of the effects, in working, of quick-revolution engines and of high-speed machines, because the movement of the films, slowed-down, might render possible the detection of defects which would otherwise not be noticed.

Mr. C. M. WALTER (Birmingham), in seconding, said that comparatively few had appreciated what could be achieved by high-speed gas-engines. He thought the fact that they could be used for driving alternators in parallel was sufficient evidence of the small amount of cyclical variation that took place. It was a more simple matter to start them than it was to start a steam-engine; they were apparently started on full compression. He felt the question of high-power gas-engines was likely to be solved by the use of these engines, because the great difficulty had been the inflexibility of the horizontal slow-speed engine for varying loads. One had to look forward to the generation of electric power by gas, and the transmission of the power electrically. He was impressed by the small amount of wear and tear on these engines compared with the horizontal type.

Mr. T. F. E. RHEAD (Birmingham) spoke on the point of the mixture of gas and air taking place inside the cylinder, and not before admission to the cylinder, and inquired whether any experiments had been made on the method of mixing. It occurred to him that the rate of explosion might have a bearing on the power developed.

Mr. T. H. POULSON (Stafford) said he was agreed that the undersides of bed-plates of all engines should be planed. Without planing there might be cracking or undue strain placed upon the bed. He desired to know if there was much noise from the spur-wheels, one of which was of cast iron and the other of steel. As regards lubrication, he thought a system of oiling by compressed air would be more reliable than the oil-pump. Referring to sediment in the water-jacket, he asked if any trouble were experienced in consequence, through the casings cracking, and if Mr. Green could recommend any fluid for dealing effectively with incrustation. Viewed from the aspect of economy only, he could not understand why gas-engines were not used to a greater extent. At the works at which he was engaged, they formerly had a 40 H.P. steam-engine, which cost about 9s. per hour for fuel. It was taken out, and a 50 H.P. horizontal "National" gas-engine was installed, the cost of which was 1s. 9d. per hour. Another important consideration was the quiet running.

Mr. H. R. LAMB (Birmingham), speaking from an electrical point of view, said that in order to guard against unsatisfactory running of alternators in parallel, it was necessary to satisfy two conditions. There must be a limit to the amount of angular displacement from uniform running due to periodic irregularity in the turning moment of a prime mover. Such recurring displacement caused objectionable swinging of the ampere meter needles; and, if excessive, it would lead to fluctuation in lighting, and throw out of step synchronous machines running on the system. A periodic angular displacement of $2\frac{1}{2}$ electrical degrees (taking 360° per cycle) from the position of uniform rotation, with a machine of the ordinary type, would cause 15 to 20 p.ct. exchange current. The angular displacement should not exceed this limit of $2\frac{1}{2}$ electrical degrees.

Mr. HOLLIDAY (Messrs. Belliss and Morcom) pointed to the increasing demand for very large engines for generating stations, and said it behoved them to see that engines were provided which would develop more than 1500 H.P. In the case of the 12-cylinder engines, there was the possibility of trouble arising through the unequal distribution of power. While the ammeter registered the total current developed, one was not told the load carried by any particular cylinder. As to the use of steel and cast iron in the constitution of spur-wheels, he had found, from recent experience, that the combination did not give good results. The only difference in the conditions, apparently, was that Mr. Green had spur-gears, while he had skew-gears; and he had to replace them. He desired to know, moreover, how an engine could be changed-over, in regard to working, from one type of gas to another, without altering the compression. There was one instance in Birmingham of a 2000-H.P. gas-engine operating on the two-cycle principle, and working in parallel with a steam-turbine. With such an engine it was possible to dispense with the fly-wheel, as sufficient weight could be got into the alternator. In developing large engines of this kind, close attention would have to be given to the two-cycle type. The difficulties became more acute as the sizes were increased. What they had to aim at was a cylinder of simple construction, with no pockets, and with the piston so arranged that it would always ride true in the centre, and thus obviate wear.

The PRESIDENT said it was certainly difficult to understand why the engines described by Mr. Green were not in more general use. He had no doubt that, when their advantages were better understood—reliability, convenience, and economy—many such enbines would be installed. There was, of course, nothing really new in this type of engine, because all petrol engines, as they were called, were really nothing more than quick-revolution gas-engines. The mechanical construction was practically identical. The providing of motor vehicles with gas-containers and supply bags meant the conversion of the engines into quick-revolution gas-engines. He asked if any difficulty was experienced in withdrawing the piston through the top of the cylinder, if the engine had been in use for some months, through the rings catching the groove, which might be expected after some amount of wear. He was surprised to find that the thermal efficiency of the engines was low compared with normal experience with horizontal gas-engines—amounting to only 26 p.ct. on full load. As to the advent of the gas-turbine machine, engineers were now aware of the difficulties to be overcome; and he joined with Mr. Green in the hope that, when it did arrive in practical form, it would be a British production.

Mr. GREEN, having acknowledged the vote, said he was afraid the cost of the vertical engine was higher than that of the horizontal engine, though he was unable to understand why the vertical engine should not be cheaper than the other. After the war there should be great scope commercially for the vertical engine. Consulting engineers found that quick-revolution steam-engines had given confidence so far as reliability was concerned; and, on the strength of this, quick-revolution gas-engines had been installed. The question with regard to the two types of gas-engines was largely one of personal taste; but in many cases he was absolutely certain that the advantages derived from the vertical over the horizontal type were many. He agreed that the present limit of size of vertical engines was one demanding very careful consideration. What they wanted were engines above 1500 H.P. Comparatively few large triple-expansion steam condensing engines were being installed, but plenty of steam-turbines. His belief was that large gas-engines could be put in with better thermal efficiency than could be given by steam-turbines up to 3000 B.H.P. When normal conditions were restored, he thought we should see the production of two-cycle engines. As regarded noise from spur-wheels, if they were properly tuned-up, there should be no more noise from the gas-engine than was occasioned by an ordinary steam-engine. He agreed that trouble might be occasioned by sediment in the water-jacket. In such cases it was fatal to have the water-pump driven from the engine. Indicator cards were of advantage. These would show if a cylinder were furred-up. If the piston-rings were of the correct metal, there should be very little difference in efficiency after two years' working. The transfer from producer to town gas could be made without difficulty or interference, when the change-over was required only for short runs. Gudgeon pins should be made of special steel, case hardened. The brasses should be lined with white metal, or not too hard phosphor bronze. It should be possible to use a forced-lubricated gas-engine for two or three years without any wear taking place in this section. As to withdrawing the pistons after a year or two, there should be no trouble due to the rings having worn a groove in the cylinder-wall if a correct over-run allowance had been made in the first instance. For thermal efficiency, excellent results were obtained from the horizontal long-stroke slow revolution type, on an I.H.P. basis; but better thermal efficiencies could be secured on full loads on the B.H.P. basis on the quick-revolution type, owing to the higher mechanical efficiencies.

A REPORT ON PROGRESS IN ILLUMINATION.

The Committee on Progress of the Illuminating Engineering Society of America preface a long annual report prepared for the 1916-17 "Correspondence Convention" by remarking that the past year has been marked by a steady growth in the perfection of methods and appliances, rather than by any striking development or elaborate display. The effect of the war is most noticeable in the extension of flood lighting for protective purposes, and in the night illumination of factories. It is indicative of the growing appreciation of the value of research and experimentation that both in France and Italy suggestions for national laboratories have been submitted; while in Japan a National Research Institute was already on the way to completion in 1916. Furthermore, in France, an Optical Research Institute has been proposed.

Work is being done along the lines of gas-lamp standardization in the way of rating—a new departure which aims to put the rating of gas-lamps on a basis comparable with that of electric sources. Neither among light sources nor in their measurement has anything of a revolutionary character been announced; and yet it is a commonly acknowledged fact that, from the standpoint of efficiency in the source, light production is still in its infancy. The following points are taken from the section of the report which deals specifically with gas.

As a result of research, some very interesting information on the early history of gas lighting in New York City has been unearthed. Gas was first introduced in 1823, when the population was only about 150,000. The first gas company was incorporated at that time; and the home of its President was the first house to be lighted by gas in New York City.

A gaseous mixture discovered by a Swiss chemist is now offered as a substitute for acetylene. It is produced by decomposition of calcium carbide and hydrocarbon oils; the heat generated by the carbide being utilized to vaporize the oil. It possesses characteristics that distinguish it from acetylene, oil gas, or a mixture of

the two. It is claimed that it can be used satisfactorily in a mantle burner.

A self-shaping high candle-power inverted gas-mantle has been described which, it is claimed, is not affected by dampness or climatic changes, and is made to withstand hard usage before burning. It is composed of a special fibre treated by a secret process and turned into a hydroxide state to make it non-shrinkable.

The Committee on Gas Lighting of the American Gas Institute have resolved to enter into an investigation to determine the most adaptable gas mantle or mantles for general use for maintenance purposes. This investigation is to embrace all the elements of research requisite in a comprehensive study of the subject.

In co-operation with the American Gas Institute, the Bureau of Standards have been making an experimental study of conditions which must be taken into account in the rating of gas-lamps. The investigation has included measurements of the candle-power and efficiency over a wide range of gas consumption for several types of lamps at different gas pressures.

At the 1916 convention of the American Gas Institute, a report was presented giving the results of an inter-laboratory comparison of the efficiency of certain mantle gas-lamps—an inverted, an upright, and an arc. Each type of unit was accompanied by a number of mantles specially selected for uniformity, so as to eliminate differences due to this cause. At two laboratories integrating spheres were used; a radial photometer being employed at another laboratory. Each lamp was tested at 2-in., 3-in., and 5-in. water pressure. The lamp rating was determined on the basis of lumens per B.Th.U. per hour. The results did not fulfil the hope that lamps could be rated to the same efficiency in different laboratories.

A development in the use of high-pressure gas lighting is particularly valuable in factories where there is much dust or fluff in the air. A duct conveying fresh air (free from inside dust) from outside is led through the building; and at various points in its length the high-pressure gas is so coupled that each connection supplies, by means of one injector, a number of high-pressure burners. A special burner is used, fitted with a small square opal reflector. No globe of any kind is required; but a wire gauze is hung below the nozzle to intercept fallen broken mantle-rings. One of the advantages of the system is that the injector can be made of such a size that it will not be choked-up.

The great need of oil for use in the navy has emphasized the desirability of the heat unit as a standard for gas quality. It would appear from the reports from England that, despite the removal of tedious legal procedure, applications for change from the illuminating to the calorific standard have not been as numerous as it had been hoped. Only about one-fourth the gas supplied in Great Britain is under the heat unit standard. The Public Service Commission of New Hampshire has modified the Standards for Gas Service, by changing the calorific requirements from 600 to 565 B.Th.U. At Sioux City (Iowa), the Council have eliminated the candle-power standard for the local gas, specifying a 600 B.Th.U. heating standard. In Chicago, an ordinance agreed upon by the Council and the Gas Company, dropping the candle-power requirement to 16, with subsequent further lowering to a limit of 9, and specifying 565 heat units per cubic foot of gas, has been adopted. Special provisions for free lamps and mantles at a reduced price to be furnished by the Gas Company have been placed in the ordinance.

The Bureau of Standards have been making an investigation, in connection with the substitution of the calorimeter for the photometer in Chicago, as to the effect in the incandescent burner of gases of various calorific powers. The general result is to put in favour a lower calorific quality of gas than has hitherto obtained. It was found that the fluctuations from maximum efficiency with changing conditions are less (despite inattention to adjustment) with gas of lower than of higher calorific value. The investigation also covered the effect of average pressure maintained, the rate of gas burning, and the air-shutter adjustment. The Bureau recommend encouraging the change from open-flame burners to the use of gas-mantles.

The substitution of a calorific for a candle-power standard is gradually taking place in Rhode Island. The New York State Public Service Commission have fixed the calorific standard in the second district of New York State at 585 B.Th.U., which is to be the minimum monthly average. This standard has been decided on after seven years of scientific and judicial study of the subject.

In connection with the discussion on the calorific standard for gas, the large number of open-flame burners still in use has been brought into prominence; and a very decided effort is to be made to have them eliminated.

National Gas Council.—The first annual general meeting of the National Gas Council will be held at 4 p.m. on Tuesday, the 11th prox., at the (small) Kingsway Hall, Kingsway, W.C.—near the Holborn Restaurant—when the annual report and accounts will be submitted.

Society of Arts.—The arrangements for the 1917-18 session of the Royal Society of Arts include the Inaugural "Trueman Wood" Lecture, by Sir Dugald Clerk, D.Sc., a series of three Cantor Lectures by Mr. Charles R. Darling on "High Temperature Processes and Products," and a paper by Lord Leverhulme on the "Relations between Labour and Capital—Reasonable Hours, Co-Partnership, and Efficiency."

SIMPLE PIPE-FLOW FORMULÆ.

The American "Gas Age" summarizes the work done in this direction by Mr. J. M. Spitzglass, in the laboratories of the People's Gas Light and Coke Company of Chicago, which shows that the loss by friction depends not only on the physical character of the interior surface of the pipe, but also varies as the diameter. The experimental co-efficient F is found in terms of the diameter D, to be

$$F = 0{\cdot}00285\,(1 + \frac{3{\cdot}6}{D} + 0{\cdot}03D),$$

which gives a minimum value when D is about 11 ins.

On this basis, the following data have been calculated:

For high-pressure gas $Q = 66{\cdot}5K\sqrt{\frac{PA}{SL}}$

„ low-pressure „ $Q = 3550{\cdot}\ K\sqrt{\frac{h}{SL}}$

„ water $Q = 53{\cdot}4K\sqrt{\frac{H}{L}}$

„ steam $W = 85{\cdot}2K\sqrt{\frac{Pw}{L}}$

Q = cubic feet of gas, or gallons of water, per minute.
P = friction drop on pressure, in pounds per square inch.
A = absolute mean pressure on line (Gauge + 14·7), in lbs.
S = specific gravity of gas. (Air = 1.)
h = friction drop in pressure, in inches of water.
L = length of pipe in feet.
H = friction drop of hydraulic head in feet.
W = pounds of steam flowing per minute.
w = density of steam at mean pressure, pounds per cubic foot.
K = co-efficient as per the following table.

Values of "K" for Various Diameters of Pipe.

Nominal.	Actual Diameter.	K =
½ inch	0·622	0·117
¾ „	0·824	0·265
1 „	1·049	0·532
1¼ „	1·380	1·171
1½ „	1·610	1·816
2 „	2 067	3·675
2½ „	2·469	6 015
3 „	3·068	10·940
3½ „	3·548	16 23
4 „	4·026	22·95
5 „	5·047	41·75
6 „	6·065	68·00
8 „	7·981	138·5
10 „	10·020	246·8
12 „	—	387·5
14 „	—	567·0
16 „	—	785·0
20 „	—	1340·0
24 „	—	2065·0
30 „	—	3470·0
36 „	—	5265·0

Health of Munition Workers Committee.

In connection with the important subject of industrial canteens, the Health of Munition Workers Committee submitted some time ago a report prepared by Dr. Leonard E. Hill, F.R.S., on some investigations of workers' food, together with suggestions as to dietary. This report Dr. Hill has now revised; and he has incorporated in it a considerable body of new material which has been collected by himself and by Captain M. Greenwood, R.A.M.C. In view of the fact that the Committee consider this new material is likely to prove of substantial interest and value in connection with the practical problems at present under consideration, the revised edition of Dr. Hill's report has now been issued as Memorandum No. 19 of the Health of Munition Workers Committee. In order to determine the kinds of dietaries provided for munition workers, specimen meals were obtained, by personal visit or otherwise, from a number of canteens attached to munition works, and, to serve a a contrast, from other sources as well. The amount of protein fat and carbohydrate in each meal was estimated, and the calorie value was calculated. The results are set forth in tables which may profitably be studied by those who are concerned in the management of canteens, and, for the matter of that, by all who interest themselves in food questions. It is pointed out that, while it is most necessary at the present crisis to prevent all waste, it would be an unwise policy to urge the nation to underfeed, and by so doing reduce the output of munitions, food, ships, &c., and increase the numbers of discontented, miserable, and sick. The voluntary ration of bread, meat, and sugar must be largely supplemented by substitutes for workers of all kinds, for proper feeding is essential to the maintenance of efficiency. Therefore the value is emphasized of well-arranged canteens, of which "the more enlightened employers and organizers of labour now realize the importance in facilitating output."

Rev. P. R. Sleeman, one of the Directors of the Bristol Gas Company, died at Clifton yesterday (Monday) week.

GAS FURNACES: THEIR DESIGN AND MANIPULATION.

By Arthur Forshaw, M.Sc., Chief Chemist to Messrs. John Wright & Co., of Birmingham.

[A Lecture delivered to the Manchester and District Junior Gas Association, Nov. 2.]

(*Concluded from p.* 331.)

Oven Furnaces.

Having spent a considerable time in dealing with furnaces for melting metal and their application, I must now turn your attention to another great branch of furnace work—viz., to furnaces for the heat-treatment of solid metals. This comprises open oven and closed muffle furnaces, and all the various operations that may be performed by their aid. In practice, the closed muffle, in which the products of combustion do not come in contact with the work, is relatively seldom used. It naturally requires a considerably larger amount of fuel to perform any operation in a muffle than in the corresponding open oven furnace in which either the flame or the products of combustion pass over the work; and therefore, unless there is some special reason for using a muffle, the oven is preferred. The first types of oven-furnace consisted of a row of burners open to the air, the flames from which passed into the furnace and impinged on the underside of the furnace bottom (usually made of tiles), from thence passing along the tiles towards both sides of the furnace, and so round the edges of the tiles and into the working space. Exit from the working space was by way of flues in the arch of the furnace. The burners were usually natural-draught. These furnaces were not very economical, as there was no direct control of the secondary air. If quicker heating or higher temperatures than those afforded by natural draught were required, air blast burners were substituted; but these were usually enclosed, and were introduced into the sides of the furnace alternately, opposite each other, with each flame directed into its own channel under the tiles. In some cases either natural-draught burners or air-blast burners were introduced into the sides, and the flames entered above the furnace bottom. This was more often the case with air-blast burners.

Since then, much advance has been made in the direction of the control of the secondary air in natural-draught furnaces, and in that of preheating the air supply—as for instance, in our regenerative furnaces, where the secondary air is controlled by dampers in front of the furnace, and is preheated by the hot brickwork before reaching the point of combustion. In some foreign-made furnaces, considerable efforts have been expended on suitably arranging the oncoming gas and air supplies with reference to the products of combustion or the hot radiating portions of the furnace exterior, in order to get the fullest advantage of recuperation.

The "Lopress" Furnace.

It has been found that the gap between natural-draught furnaces on the one hand, and those heated by air-blast on the other, could with advantage be filled in; and for many purposes furnaces with air under slight pressure (provided by a fan) have been found satisfactory—thus avoiding the expense of the positive blower necessary for the pressure of 1 lb. to 3 lbs. used with air-blast burners. In our "Lopress" furnace we have developed this idea, and provided at the same time an effective example of recuperation. A novel feature of advantage in this type of furnace is that the gas is introduced and burned from the open ends of small pipes, each controlled by a cock and attached to a large supply pipe. The flame thus produced is a luminous one. At a suitable point, air is introduced from similar jets, and blows the luminous flame forward through flues under the furnace floor, and so into the furnace, as may be most desirable, according to the work that has to be done. The air is supplied to the small jets from a large main or mains round which the products of combustion circulate on their way to the flue outlets. The air pressure required is in the neighbourhood of 6 in. water gauge for high temperatures.

The particular merits of this type are that it heats up more rapidly than the natural-draught type, and is more economical of gas. It only requires a fan for the air pressure, as against a positive blower for the air-blast type. It has a solid bottom with the flues built in, instead of tiles or slabs, and will consequently stand more hard work. But, most important of all, it enables any quality of flame to be obtained to suit the work in hand. It is the only gas-furnace for instance, where the "greasy" flame so necessary to prevent scaling can be satisfactorily ensured—a flame such as one sees in ovens heated by bituminous slack. This is invaluable in heating work, where scaling is inadmissible or must be reduced to a minimum.

General Design of Oven-Furnaces.

There are several points about design in oven-furnaces to which I should like to direct your attention. In the heating-up of material, the three modes of transference of heat all have their part. Take the case of a flat plate of iron laid on the bottom of a furnace heated by burners under the floor slab. The upper side of it is heated by radiation from the roof or arch and from the walls. It is also heated by the impingement on it of flame or the products of combustion, while the underside is heated by conduction, and by radiation from the slab. It will, therefore, be heated rapidly and equally all over. In the further case of a number of flat plates placed on the top of one another, or a number of bars or tubes piled up, it is clear that the furnace will require as much bottom-heat as possible; otherwise the whole of the material except the top layer must be heated by conduction from that layer, with the result that the top layers are overdone before the bottom layers are more than warm. For reasons of this sort, there are few cases in which we find it advisable to recommend a furnace having a solid bottom, and heated directly by burners placed in the upper part of the furnace. As a matter of figures, it is possible in a space so heated to attain a given temperature with approximately half as much gas as in one heated below the slab. But mere demonstration advantages such as this are of no actual benefit, because if a furnace is not suitable for the work, the furnace in particular and gas-heating in general, quite undeservedly suffer in reputation.

Annealing.

Let us now consider for a short time the different operations to which oven-furnaces are adapted. First, we will treat of annealing. This is a term sometimes used to express different operations, though usually it means a heat-treatment applied to metals that have been mechanically worked in some way—for instance, hammered, bent, drawn, or rolled—or to metals, like steel, that have been hardened by quick cooling from high temperatures. It means heating them up and cooling them slowly through certain critical temperatures. The mechanical working referred to usually gives a product in which there is internal strain of some sort, resulting in inability to stand further stress, or in a tendency to revert to a previous form.

A very good example of this is the production of cartridge cases. The cast ingot is passed through rolls, which perform the "breaking-down" operation as it is called—the ingot is increased in length and decreased in thickness. After the first rolling, it is still much thicker than is required for blanking. But before anything further may be done to reduce it, the metal must be annealed; otherwise it would crack or break under the next operation. After annealing, it may with safety be rolled again. But it must be annealed several times in all before it finally arrives at the correct thickness for blanking—*i.e.*, punching-out the blanks from which the individual cases are made. Again, during the drawing processes by which the blank is caused to assume the shape of the finished case, several annealings must be carried out. If the correct number of annealings is not carried out, the finished product is in a state of molecular strain, and the result is it eventually cracks. This last result of the effort on the part of the metal to return to a state of internal equilibrium may not show itself for some months, and is known as "season cracking." We have had experience of cases of it in solid-drawn brass tubes which have been in use for some time; while it has been known to occur in cartridge cases after they have been stored between six and twelve months.

The importance of the particular temperature at which annealing is performed calls for mention. Some important experimental work has been done by Charpy on brasses, and among them this same alloy—viz., 70/30 brass. In its natural state it has a tensile strength of about 18 tons per square inch. He found that after hammering and rolling sufficiently, this is increased to a maximum of about 32 tons. The annealing experiments showed that up to about 300° C. there was very little effect on the metal; but above this temperature, and up to 600° C., there was a gradually increased softening. At the latter temperature the tensile strength had dropped to about 17 tons per square inch, after which it remained about constant up to 850° C.; above 900° C., it was over-annealed or burnt.

Usually speaking, the annealing of steel is a very much more interesting subject than that of non-ferrous metals. In order to follow the annealing and heat-treatment generally of steel, some knowledge of its composition, both chemical and structural, is necessary. To give a detailed account of such a subject as the micro-structure of steel would require, however, all the time at my disposal, and therefore cannot be attempted. Still, such a slight idea may be given as will help the changes in steels by heat-treatment to be intelligently followed by those who have not made a study of it.

Steels and their Properties.

Ordinary steels may be roughly defined as alloys of iron and carbon. Steel—that is, iron containing carbon—exists in several different forms; and the heat-treatment of steel is mainly concerned in ensuring that we shall obtain the particular form of alloy that we require. True steel—in which I am not including for the moment the special alloys containing nickel, chromium, tungsten, vanadium, &c., which are also classed under the name steel—can be forged and welded, and all of them can be hardened and tempered by heating and sudden cooling, or softened and toughened by heating and slow cooling.

THE INFLUENCE OF CARBON.

As the percentage of carbon decreases, so does the property of hardening, and at about 0·2 p.ct. it is practically *nil;* while as the carbon increases, the welding property and the forging property decrease, till at 1·2 p.ct. of carbon, steel is not weldable by ordinary shop methods, and at 2 p.ct. it cannot be forged. The ordinary steels, then, contain somewhere between 0·2 and 1·5 p.ct. of carbon.

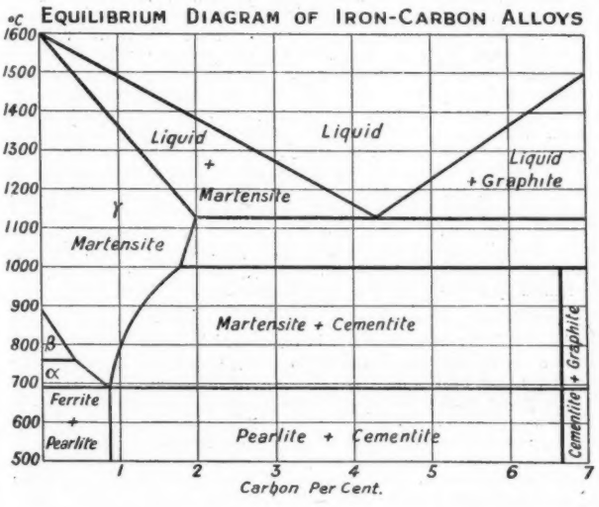
STEELS CONTAINING UP TO 0·9 P.CT. OF CARBON.

If such steels, containing up to 0·9 p.ct. of carbon be slowly cooled after solidification, they exist above 890° C. as practically homogeneous solid solutions of carbon in iron. This form may be rendered permanent by sudden cooling, and is known as martensite. Below 700° C. slowly-cooled iron is incapable of retaining carbon in solid solution. The carbon therefore separates out in the form of the carbide of iron (Fe_3C), known as cementite; the iron not used up to form this compound being left pure, and called ferrite.

To make the story complete, ferrite and cementite form a further alloy (21 Fe + Fe_3C), known from its appearance under the microscope as the pearlite eutectoid, which persists in the cold steel. As this eutectoid contains about 0·9 p.ct. of carbon, it is obvious that a slowly-cooled steel containing 0·9 p.ct. of carbon will consist wholly of pearlite; while below 0·9 p.ct. of carbon it will consist of a mixture of ferrite and pearlite; and above this percentage, of a mixture of cementite and pearlite. As revealed by the microscope, pearlite consists of a number of thin plates of ferrite and cementite alternating in sandwich fashion. On cooling slowly—between 890° and 700°—changes take place. In steels up to 0·9 p.ct. of carbon, the whole mass ceases to be a homogeneous solid solution of carbon in iron, and gradually separates into a mixture of solid solution and pure iron—the carbon, as seen under the microscope, is found to be concentrated in those parts consisting of solid solution; while the other parts, being pure iron, contain no carbon. To put it in another way, the area of martensite becomes less, while the area of ferrite grows. As the percentage of carbon in the steel as a whole, increases, the temperature at which this change starts is lowered, so that with 0·45 p.ct. of carbon, instead of occurring at 890°, it occurs at 760°. All the same, when 700° is reached the solid solution of carbon—*i.e.*, martensite—cannot persist, and the carbon, as already described, is separated out as the compound iron carbide (Fe_3C), cementite.

STEELS CONTAINING OVER 0·9 P.CT. OF CARBON.

So far we have been considering steel containing up to 0·9 p.ct. of carbon. Now let us glance at the steels containing above 0·9 p.ct. and up to 1·5 p.ct.—the upper limit of carbon which we took for our purpose. Above 950° the steel exists as before in the form of solid solution of carbon in iron—martensite. As it cools, however, there is more carbon present than can be retained in solution, so that some of the carbon combines with the iron and forms cementite. This commences at approximately 950° C. in steel containing 1·5 p.ct. of carbon, and as the temperature drops, the cementite increases. The lower the total carbon, the lower the temperature at which the cementite begins



to form. When 700° C. is reached, the martensite cannot persist, and splits up into cementite and pearlite, as already described [see diagram]. The first important point to notice is that, whatever the percentage of carbon, all steels above 700° C. contain martensite; and it is this constituent which is characteristic of hard steels that have been quenched above (say) 760° C. The second point is that, slowly cooled to below 700° C., all steels contain cementite. Cementite is in itself an extremely hard substance, and withal brittle. In annealed steels below 0·9 p.ct. of carbon it exists (as already mentioned in conjunction with ferrite) as pearlite, and also surrounded by more or less free ferrite. Ferrite, however, is tough and soft; so that the lower the percentage of carbon the tougher and less brittle is the steel. Even at 0·9 p.ct. of carbon, where the whole mass consists of pearlite, the ferrite layers in this give it a certain amount of toughness. As 1 p.ct. of carbon is exceeded, free cementite becomes greater in proportion, so that the steels become naturally harder, but more brittle from the progressively smaller amounts of pearlite, and therefore of ferrite, which they contain. With these facts in mind, we are able to appreciate the changes that occur in annealing, hardening, tempering, and case-hardening, and at the same time understand why tools for different uses require higher or lower percentages of carbon in them.

THE ANNEALING OF STEEL.

A steel that has been overheated and allowed to cool slowly, without being worked, is composed of large crystals; its structure is coarse; and it is very fragile. This steel can be restored to a useful condition by heating to a good heat and forging down to dull redness; but even then it is not in an ideal state. This is particularly the case in forging articles of irregular shape which are subject to the defects of irregular extension and cooling and of cold working; while some parts may be of coarse structure owing to insufficient forging. In addition to this, during the machining of already-annealed steel, stresses are often set up which would probably cause cracking or breaking in subsequent operations. Annealing is resorted to as a cure for all these defects; and the procedure to be adopted is as follows: The steel is heated-up until the ferrite and pearlite or the cementite and pearlite, as the case may be, start to diffuse into one another, with the formation of martensite. This is the opposite effect from that mentioned when describing the cooling-down of steel. Brearley gives the following temperatures for steels containing different amounts of carbon as those at which the change will take place:

Percentage Carbon in Steel.	Lowest Temperature to which Steel must be Heated.
0·2	870° C.
0·4	810 ,,
0·6	780 ,,
0·9	750 ,,
1·1	830 ,,
1·3	890 ,,

He adds that 20° to 30° above these temperatures causes no ill-effect; but the exposure must be a short one. When the heating has been finished, the metal is cooled-down uniformly in the furnace until it is under visible redness, after which, as rapid cooling has then no effect on it, it may be cooled-down to normal temperature as rapidly as convenient.

The usual object of annealing, apart from curing the defects mentioned above, is to render the steel as soft as possible for machining purposes; and it may entail softening steel which has already been hardened by quenching. In such cases, the steel is most quickly softened by reheating to within a few degrees of the hardening temperature, and then cooling in air. If this particular temperature is exceeded, however, the steel would, on cooling in air, be harder. This is illustrated by the following table (after Brearley), showing the Brinell hardness number, on reheating to various temperatures, of a quenched steel containing 1 p.ct. of carbon:

Reheated to.	Hardness—Air-cooled.	Hardness—Quenched in Water.
500° C.	320	320
600 ,,	240	240
720 ,,	187	187
725 ,,	170	187
750 ,,	196	555
850 ,,	241	555
950 ,,	269	555

On the other hand, for thorough softening, the steel is heated to a temperature a little above the hardening point, and is allowed to cool slowly in the furnace. Some authorities consider that the former or quick method, while not giving so soft a steel as the latter, is yet preferable in some respects, as it gives a product that machines more sweetly. It will be readily understood how peculiarly gas-heated annealing furnaces lend themselves to the carrying out of operations of the kind I have been describing, affording as they do in unequalled degree the ease and exactitude of regulation which are so essential.

HARDENING.

The above table also gives us some idea of what is meant by hardening, and more need not be said about it than that water is not the only quenching medium—indeed, in many instances, oil, or preferably salt, baths are used for the purpose, as being less severe in their action than water. As a matter of fact, the hardening effect depends upon the rapidity with which the steel is cooled through the critical temperature; and it is in all cases completed by the time the whole body of the metal has arrived at 680°.

SALT BATHS FOR QUENCHING.

Baths consisting of fused salts, metals, or alloys are used for hardening, provided their temperature is low enough. This proviso has, in the past, practically excluded the use of simple salts or metals for the purpose of quenching, as there are very few simple salts, and no cheap ones, with a sufficiently low fusing point. Fusible metallic alloys, which melt at a temperature below the boiling point of water, have been tried and found

unsuitable. We have, however, recently developed the use of a substance called "Quenchene," which at ordinary temperatures is a white solid, but which is liquid at a temperature of 140° C. It might be supposed that a liquid at such a temperature, well above the boiling point of water, would not harden carbon steel successfully. But the fact is that "Quenchene" has a very powerful quenching action, mainly because, its boiling point being above 800° C., it does not form steam or vapour when the steel is plunged into it, and it retains close contact with the steel, and extracts the heat from it very rapidly, which it could not do if the article were protected by a jacket of steam or vapour. Tools are rendered glass-hard by the use of "Quenchene;" while the risk of cracking or warping is reduced to a minimum, as the temperature is sufficiently high to give rise to a distinct tempering action. "Quenchene" baths of various sizes heated by gas are in regular use in many engineering works.

Salt Baths for Tempering.

After hardening, all tools are usually tempered—that is, heated to a definite temperature. There are many ways of doing this; but the best is to immerse them in a liquid bath of some sort. The object of this is to give the tool or metal sufficient toughness to withstand the shocks to which it is put during the work it has to do—the temperature at which the operation is carried out varies from 150° C. to about 300° C. or over. It was usual to heat the tool in air until it showed a certain surface colour due to oxidation; but modern practice finds it more satisfactory to heat to a definite temperature in a liquid bath. It is practically certain that the attainment of the exact "temper" is a function of temperature, while it has also been proved that the different surface colours can be obtained at various temperatures according to the length of time the metal is exposed. The liquid bath (salts, oil, or metal) has the further advantage that the whole of the article can be heated up to the same uniform temperature; while tools like files or drills, which require local tempering or softening in the tang or shank, are commonly dealt with by dipping these parts only in lead baths. In many cases our mixture of salts, known as "Feusalt," is used for tempering articles which require a higher temperature than can safely be applied to oil. Tempering processes often demand considerable accuracy; and a "Feusalt" bath, heated by gas, is an ideal arrangement for such work.

Case-Hardening.

We now have briefly to consider case-hardening. This is a process whereby mild steel is caused to have a very hard surface to withstand wear, while the core of the article remains tough and soft. The metal to be treated, such as a cam-shaft or a gudgeon pin, is packed in a box with carbonaceous material like charcoal or yellow prussiate of potash, carbonized leather, or the like. The temperature is then raised gradually to about 900° C. The length of time during which the metal is subject to the action of the carbon determines the depth to which the latter is able to penetrate. The temperature determines the rate at which penetration proceeds—usually this is somewhere about one-hundredth of an inch per hour. During the casing process great care has to be taken to get the furnace evenly heated, because otherwise—as will be recognized—the "case" will not be of equal thickness all over the objects treated. After this treatment, the internal core is often in an undesirable state, due to the prolonged heating. This may be remedied in more than one way. For instance, many articles are quenched in oil direct from the hardening boxes. This leaves the core in good condition, and prevents the formation of crystals during the cooling; but it is bad for the "case." The articles are accordingly reheated to about 760° C., and again quenched—this time either in water or oil. The second heating does not injure the core, which has already been satisfactorily dealt with; but it greatly improves the "case," rendering it very hard, and close-grained.

Another treatment consists in allowing the articles to cool in the box. They are then withdrawn from the box, reheated to about 820° C., to deal with the core, and quenched in water. Subsequently they are reheated a second time to 765° C., and again quenched in water, to get the "case" into the desired condition. The reheating of carbonized work is best done in baths containing "Pyromelt." The "Pyromelt" leaves the surface of the articles (after quenching) glass-hard, and work so treated is in the best condition, because the temperature can be regulated to a nicety; also no part of the article can fail to be heated up to the right temperature, and no part can possibly be overheated. Large numbers of gas-heated salt baths are in regular use for the reheating of carburized work.

Rustless Fuse-Caps.

Heat treatments are carried out in oven furnaces for a variety of purposes not included in the above. For instance, perhaps the latest we have designed is in connection with cast-iron fuse caps. When made of this material, it is necessary to put the fuses through some process to prevent them from subsequently rusting. Of our two appliances for this purpose, the non-automatic form for this consists of an oven furnace in which the fuses, mounted on trays each containing fifty, are heated and then quenched in cotton-seed oil. This gives the fuse a rust-proof black surface. The temperature must be within the limits of 650° and 700° C. Below 650° the fuses would not take the surface; while above 700° "growth" of the cast-iron commences and prevents the fuses passing the subsequent strict gauging tests. In our automatic apparatus the fuses are placed one by one on holders which are passed through an oven furnace by an endless chain. At the outlet end they are automatically quenched in the oil, and drop on to a conveyor which brings them out from the oil again. I only mention this particular process because it is practically a new one. The ordinary processes of heat-treating war material like cartridge-cases, cartridge-clips, bayonets, digging-tools, and the many other articles in general, have been frequently described. They all fall under one or other of the processes I have described under annealing, hardening, &c.

Manipulating the Oven Furnace.

Before leaving oven furnaces, I should like to give a few points concerning their care and manipulation. Generally speaking, they are not called upon to stand such high temperatures as crucible furnaces; and it may be expected that the walls and arch will last an indefinite time. The place where wear shows itself soonest is, of course, the bottom, where heavy weights are often placed. When the bottom is of slabs or tiles and heated from underneath, it will be seen that breakage can easily occur; and this consideration has led to many furnaces being built with solid bottoms containing flues, such as the "Lopress" furnace already referred to. Another thing to watch for is the dropping of scale or slag on the brickwork. This is always occurring; and it is as well to get rid of these materials at regular intervals.

Usually an oven furnace is built with the working-space bounded by upright tiles or bricks. These prevent much scale getting into the combustion-space below the slab. If these tiles are absent, the bottom slabs should be periodically removed, or an accumulation of such material may block the combustion-space, or the burners, and thus interfere with the working of the oven. In the manipulation it is a good plan to work with as little primary and secondary air as the operation will permit. An intelligent use of the primary and secondary air sleeves and of the flue dampers will enable the user to save much gas. I have seen, in an oven fitted with a pyrometer, where the temperature was running constant, a difference of 100° C. either way, caused by slight manipulation of the air and flue dampers alone. One cannot give exact directions; but the correct manipulation will be found after experience, and depends on the temperature desired, the work to be done, the pressure of the gas, and so forth. In general, it may be said that sufficient advantage is not taken of the regulators provided. In all furnaces, but particularly for exact work like case-hardening, &c., it is a great advantage to fit a gas-governor.

Heat Insulation.

Another point in connection with the saving of gas may be mentioned. Some years ago we carried out a series of experiments on the heat insulation of furnaces; and as a result we were able to reduce very materially the heat lost by radiation and convection. But every user can increase the insulation for himself by spreading the outside of the furnace with any of the usual insulators. In this way he not only saves gas, but promotes the comfort of the workmen.

High-Speed Tool Steel.

Before leaving the consideration of oven-furnaces, it is necessary to mention those employed in the hardening of high-speed steel. The whole subject of these special steels is of great interest, and is by no means in the comparatively explored and settled state of the carbon steels. The properties expected from high-speed steel are those of hardness and resistance to the softening effect of heat. A turning tool, for instance, will cut mild steel at such a rate that its point is raised to a temperature of from 500° to 600° C. without softening. The ability to perform work of this sort depends first on the composition of the tool and then on the heat-treatment to which it has been subjected. When heated to 900° to 950° C. and quenched in oil, high-speed steel is quite hard; but it is not possessed of "red-hardness"—viz., the characteristic property of high-speed steel, of cutting mild steel at high speeds for a long time. This can only be ensured by the correct heat-treatment.

Hardening High-Speed Tools.

In the first place, the tool is presumed to be in the annealed state. It is then hardened from a high temperature—say, between 1200° and 1300° C. At this temperature, which varies slightly for each particular brand of steel, the formation of a double carbide of chromium and tungsten dissolved in the iron is supposed by some authorities to take place. It is not good practice to heat the steel directly from cold to this high temperature, on account of the tendency to crack. In the furnace we specially designed for the purpose of hardening high-speed steel, we provide two chambers. One is heated directly by a powerful burner to a temperature rather above that at which the solution of the mixed carbides occurs; the other, or preheating chamber, heated by the waste products from the first, attains a temperature of 800° to 900°. The tool is first placed in the preheater and raised to redness. It is then transferred to the hot chamber and rapidly heated. When the change takes place in the constitution of the steel, it absorbs heat and appears to be slightly darker in colour for a short time. As the change is complete, the tool visibly rises in temperature again—starting with the thinner parts. When uniformly hot, it is removed from the furnace and often cooled in an air-blast or quenched in oil; but we prefer to quench in "Feusalt," at a temperature of about 230° C.

"Feusalt" has already been referred to as in use for tempering; but it has a very wide application for quenching high-speed steel. The particular advantage is that the tool is cooled much more swiftly than in cold air, and yet the risk of cracking is much reduced; for when the quenching in "Feusalt" is complete the temperature is still so high that the strains are relieved, and the tool has time to adjust itself to the new conditions. The uniformity of cooling in a bath of "Feusalt" is very advantageous in comparison with the irregular cooling in an air-blast—the air-blast chills the sharp corners and outer portions of the tool, while other parts are still red-hot. Under the action of an air-blast the different parts of a circular tool—for instance, the outside circumference and the hole—may differ in temperature by hundreds of degrees for some length of time; but in a bath of "Feusalt" they are very quickly brought to the same temperature. For this and other reasons high-speed tools quenched in "Feusalt" are much better than those cooled in an air-blast.

General Reflections.

I have so far dealt with the furnaces in general use, and the work they are put to. When one considers special furnaces that have been made, one is astounded at the numerous possibilities for employing gas. It is, however, impossible for me to deal with this side of gas-heating at present; it would require a paper to itself. But I cannot miss the present opportunity of saying something on the subject of coal gas itself, as suggested by the experience we have gained in gas-furnace matters.

The Importance of Standard Gas.

When I last addressed this Association, I laid emphasis on the view—which, indeed, we have long held and frequently expressed—as to the need for uniformity in the quality of gas supplied by the gas undertakings; and I described the difficulties of the gas-heating engineer, owing to the wide diversity shown in different parts of the country in such matters as pressure, calorific value, composition due to the various qualities of coals, thermal treatments, percentage of water-gas, &c. This need of uniformity is as great to-day as it was then, and in some respects it is more acute. The ground, however, has shifted somewhat.

Owing to the present circumstances, calorific value has, on the whole, tended to become more uniform. Gas engineers have had to be content with what they could get in the way of supplies of material; and there has been a general tendency for the higher calorific values to drop. But while any movement towards uniformity in this direction is to be welcomed, it is necessary that it should not take place at the expense of uniformity in other directions. At the risk of repeating arguments with which you may be familiar, I must say that we, as gas-heating engineers, cannot look with equanimity on the reduction of calorific value if it is brought about by dilution with inert gases, nor do we welcome continually-varying percentages of water gas or high specific gravities. It is highly important in many gas-furnace operations that a high flame-temperature should be attained. As the percentage of incombustibles rises, this property is impaired. Again, water gas requires, volume for volume, less air than the coal gas it replaces. A sudden jump from (say) 10 p.ct. to 35 p.ct. of water gas—a not unknown happening—has a very considerable effect on a flame that has been set for the former percentage. Generally speaking, we do not mind low calorific value—we have melted much metal by blue water gas alone; but we do ask you, as gas engineers, to assist us in the matter of flame-temperature, unfluctuating pressure, and unvarying percentages of constituents likely to upset flame quality, and as far as possible to standardize the chief product of the gas-works, so that, in whatever part of the country it may be, a reasonably constant quality of gas can be counted on. This is not merely a selfish request on our part. The essence of cheapness is standardization and the consequent output it allows; and uniformity in gas quality promotes standardization in apparatus, and so favours increase of output and cheapness.

Standard Gas—Another Aspect.

Important as the question of standardization of gas is from our point of view, in closing I must direct your attention to a more serious side of it from your point of view. You, as gas engineers, are trying to create and maintain a large output of coal gas for industrial purposes. The war, with its unparalleled call for explosives and for munitions, has enabled your output to increase by leaps and bounds. What will happen to this increased output when the war is over? I would urge that you supply a standardized product at a price that can compete favourably with rivals like solid-fuel, oil, water gas, and producer gas; otherwise the present rate of increasing gas output—on the furnace side at any rate (which I would point out is mainly due to the war)—cannot be expected to go on increasing, once the war is over, but will receive a check. I speak with knowledge when I say that the demand for these alternative fuels is an insistent and an increasing one. I hope I have said enough to indicate the great opportunity which, in my opinion, lies in front of the gas undertakings, and to show that the future of industrial coal-gas furnaces depends to a large extent on their policy in the next few years. If I have in any degree made these points clear, I shall have so far fulfilled the purpose of this lecture.

To my various colleagues associated with the firm of John Wright and Co.—the results of whose chemical and technical work, along with my own, is embodied in this paper—I desire to express my acknowledgments, as well as to the Company itself, for permission to avail myself of the records of this work in the preparation of the lecture.

DISCUSSION.

At the conclusion of the lecture,

The PRESIDENT (Mr. W. Buckley, of Manchester) said he was sure they had all been interested in so valuable a lecture. Mr. Forshaw was essentially a practical and scientific man; and he had shown these attributes throughout the lecture. As the name of Mr. Shipley N. Brayshaw had been mentioned, he proposed to invite that gentleman to say a few words, after which he was sure Mr. Forshaw would be only too glad to answer any questions addressed to him.

Mr. SHIPLEY N. BRAYSHAW, in thanking the President for the opportunity afforded him of saying a word or two, said he, too, had been very much interested in the lecture. He was quite sure that gas was going to be used enormously more in the future than it had ever been in the past. There were new and extensive developments taking place everywhere; and he thought there were now more people working on experimental lines than ever before. He felt confident that all that was even now being done was merely the commencement—they were only on the fringe, as it were, of great developments; and they could look forward in the course of the next few years to gas playing a greater part than ever. The close of the war would mean that a great deal of trade which had been developed would cease; but in other directions they would find that gas would be coming into its own.

Mr. F. C. BELTON (Macclesfield) asked for figures relating to the melting of cast-iron.

Mr. FORSHAW said he could not give the exact figures at the moment. But in regard to pig-iron and hematite, one series of results showed from 7 to 9 c.ft. per pound of pig-iron melted.

Proceeding, the lecturer said that, as the time was passing very quickly, his Chief Assistant, Mr. Harvey, would explain the working of the furnaces in the show-room. Mr. Harvey would answer any questions the members desired to ask. As many of them knew, Mr. Harvey was engaged on war-work furnaces, and in his (the speaker's) opinion no one knew more about the subject than he did.

The PRESIDENT, before the company proceeded to the metal-melting demonstrations, said there were several points in the lecture on which he made notes. From the lecturer's lucid explanation of the processes one could see that it paid to have scientific control when melting metal on a large scale. He desired to know whether a slightly varying calorific value had much effect on the efficiency of the interior of the furnace, and, *en passant*, said he considered that the excess of diluents in the gas would greatly reduce the efficiency of the burners. He had heard of a 500 B.Th.U. gas containing 20 p.ct. of diluents; but, personally, he did not think that this was fair to the customer—to take 500 B.Th.U., with anything up to 20 p.ct. for non-combustibles. Some undertakings returned large makes per ton of coal carbonized; but this was due to what he called exhauster gas.

Mr. FORSHAW said that the introduction of incombustible gas instead of coal gas had a very bad effect upon furnaces altogether; in crucible furnaces, it had a very bad effect indeed. For instance, in forge furnaces inert gases spoiled the flame temperature which was so necessary. "In forge furnaces, one must have the flame temperature," he reiterated. In crucible melting it was also necessary to have flame temperature. But with an excess of diluents there was considerable reduction in the flame temperature—the inert gases required heating-up, and then escaped because the diluents took the heat with them.

A demonstration of the furnaces of Messrs. John Wright and Co. followed; a large company watching a considerable time the various processes, under the guidance of Mr. Forshaw and Mr. Harvey.

An Employees' War Savings Association.

A War Savings Association was formed by employees of Messrs. Willey & Co., Ltd., in July, 1916, and the management was vested in a Committee of fellow-workers appointed by themselves from the various workshops. The success of their efforts is shown by the fact that, out of a total of 700 employees, no less than 600 are subscribers to the Association. Since the formation eighteen months ago, there have been purchased 3000 War Savings Certificates, costing £2325, of which over two-thirds has been collected from employees by the Committee, in small weekly subscriptions ranging from 6d. to 2s. 6d. This is a striking example of the utility of "little helps," and should convince all of the great possibilities of the War Savings movement. In attaining this success, the Committee acknowledge the practical encouragement given them by the Directors of the Company in the shape of fifty or sixty fully-paid certificates which have been distributed without payment, by various methods, among the members, so providing a continual interest, which is invaluable in a movement of this description.

Price of Gas at Hebden Bridge.—At the monthly meeting of the Hebden Bridge and Mytholmroyd Gas Board last Thursday, the question of the price of gas was under consideration; and having regard to the fact that the cost of coal, workpeople's wages, and other items of expenditure are constantly increasing, the Board decided to advance the price another 3d. per 1000 c.ft., and to charge prepayment meters at the rate of 1d. per 20 c.ft. These advances are to be from Jan. 1. The price of gas has now risen 9d. per 1000 c.ft. during the war.

A Successful Gas Tender.—The Marylebone Borough Council Highways Committee recently secured tenders from the Metropolitan Electric Supply Company, Ltd., and the Gas Light and Coke Company for carrying out the necessary work for lighting two wharves by electricity and by incandescent gas-burners respectively. Their quotations were: Metropolitan Electric Supply Company, £247 4s.; Gas Light and Coke Company, £190 10s. The latter Company were also prepared to undertake to maintain, clean, and keep in good repair the whole of the burners for £4 18s. 9d. per quarter. The Committee recommend that the offer of the Gas Company be accepted,

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Mr. John West's Paper on Carbonizing.

SIR,—For many years I have sat at the feet of my Gamaliel, meaning my old and esteemed friend Mr. John West, and have always imbibed wisdom. It is with the deepest interest I have read his extremely able paper, presented on Nov. 8, to the Southern Association of Gas Engineers and Managers.

With that part of the communication dealing with the steaming of retorts, I do not propose to deal, but desire to confine my remarks to the portion referring to what Mr. West terms "low-temperature" carbonization; and here I must confess to being quite unable to follow Mr. West.

In the first place, what the author describes as "low-temperature" is, in my view, not low temperature at all. It is merely dropping the temperature of fire-clay retorts from a very high temperature of some 2562° Fahr. to 1793° Fahr. What was to be learned from such a trial I fail to see, because the make per ton would assuredly drop, and the tar yield be increased. This is common knowledge, based on years of ordinary gas-works practice.

If Mr. West, by working at 1793° Fahr., hoped to increase his yield of tar oils by 100 p.ct., and to alter their character from saturated hydrocarbons (benzenoid series) to unsaturated hydrocarbons of the unsaturated or paraffin-olefine series, then he was very far from the mark.

What was done by the dropping of the temperature from 2562° Fahr. to 1793° Fahr. was to spoil the high-temperature results, and gain nothing from a genuine low-temperature point of view. The result would fall between two stools.

It has been established by Dr. Dunstan, of the East Ham Technical College, with whom my colleague, Mr. C. W. Tozer, and myself have collaborated for some years on low-temperature investigation, that the average crucial temperature of carbonization in the interior of the retorts whereby the tar oils of the paraffin-olefine series (unsaturated hydrocarbons) pass to the benzenoid or saturated series is approximately 1400° Fahr.

Therefore, it may be stated generally that operations carried out at temperatures under 1400° Fahr. are low-temperature carbonizing, and over this figure they are high-temperature processes. So, with all due respect to my friend Mr. West, I think that it is quite misleading to label his practically high-temperature results as low-temperature ones.

Dr. Perkin has thrown some light on what Mr. West, on Mr. Barton's behalf, was aiming at, when he stated that he could not "crack" low-temperature tars to yield benzenoids. If Mr. Barton requires benzenoids, then he must stick to ordinary gas-works processes. If, however, he requires paraffins yielding petrol and fuel oils in considerable quantities, he must keep to temperatures under 1400° Fahr.; and, if, furthermore, a smokeless ignitable fuel containing 7 to 12 p.ct. of volatile matter, it is even more necessary to keep to the lower temperatures.

Regarding the "cracking" of low-temperature tar oils into spirits of about 750 sp. gr., there is no difficulty, as we have accomplished it easily. But Dr. Perkin was quite right when he said that paraffin tars cannot be "cracked" to yield benzols. It would be trying the almost impossible.

Turning to the concrete instance of the tests on Kent coal, we have tested in low-temperature retorts at a temperature of 1000° to 1200° Fahr. some tons of the Kent "Tilmanstone" and "Snowdon" seams, with very good results considering the quality of the coal; and the following are the results:

Kent Coal—Tilmanstone Seam.

Yield of oils, &c., per ton of coal carbonized—	
Motor spirits	2·5 gallons.
Middle oils	6·0 ,,
Heavy oils	4·5 ,,
Total oils (water free)	20·5 ,,
Tar acids (in middle oils)	8 p.ct.
Bituminous pitch	63·5 ,,
Sulphate of ammonia	22 lbs.
Coke (smokeless fuel)	16 cwt.
Volatile matter in coke	8 p.ct.
Ash in coke	12·5 ,,
Gas per ton of (approximately) 700 B.Th.U.	6000 c.ft

Kent Coal—Snowdon Seam.

Yield of oils, &c., per ton of coal carbonized—	
Motor spirits	3 gallons.
Middle oils	8 ,,
Heavy oils	3·9 ,,
Total oils (water free)	17·3 ,,
Tar acids (in middle oils)	7 p.ct.
Bituminous pitch	62 ,,
Sulphate of ammonia	19·2 lbs.
Coke (smokeless fuel)	16 cwt.
Volatile matter in coke	7 p.ct.
Ash in coke	13·8 ,,
Gas per ton of (approximately) 700 B.Th.U.	6000 c.ft.

(*Note*—The tar acids are cresols.)

The coke was of excellent quality, hard, and compact—in fact, it was one of the best cokes we have ever produced, and contained some 8 p.ct. of volatile matter.

This coal, in my opinion, cannot be carbonized in *continuously* working retorts of the Glover-West type. It is too friable, and would yield much breeze by the moving operation. We had no difficulty in carbonizing it in four hours—about the same time as we employ for a high standard Newcastle coal.

There is one point which puzzles me in Mr. West's tabulated statement, and that is the yield of sulphate from the Kent coal. At high-temperature, he obtained 14·6 lbs. per ton, and at what he terms low-temperatures 26·2 lbs. per ton. This quite reverses my five to six years' investigations of low-temperature processes, because we find that, the lower the temperature, the less the ammonia recovered; and I can only think that the figures have been inadvertently transposed.

But all said and done, we owe Mr. West sincere thanks for the trouble he has taken, and for the careful and exact manner in which the results have been tabulated.

F. D. MARSHALL.

19, *Queen Anne's Chambers, S.W., Nov.* 17, 1917.

Economy of Steaming in Continuous Vertical Retorts.

SIR,—As one of the pioneers in vertical carbonization, I congratulate Messrs. Blundell and West on the excellent results tabulated in their papers, which I venture to augment with my own experiences, and trust thereby, by broadening the basis, extending the period, and varying the conditions, to add to this most interesting and profitable phase of vertical retorting.

In April, 1913, the first installation on the Dempster-Toogood system was set to work at Hebden Bridge. From the outset, the retorts were continuously steamed; the pressure varying from 3 to 12 lbs. through a ⅛-inch diameter orifice.

Coal.—The coal contracts running were for screened coal, unscreened coal, and nuts. Having six contracts running, and using from wagon, the day's coal in this small works was a constantly varying factor, which difficulty, as regards steaming, was apparently not experienced by the writers of the papers.

I found that with a run of nut coal, the heats much more readily penetrated the charge, so that the resultant coke towards the bottom was at a greater temperature, and the charge as a whole possessed a much greater capacity for steaming. Under these conditions, I obtained a 25 p.ct. increase in production over the rated capacity—viz., 320,000 c.ft. per bed, and 15,000 c.ft. per ton, of a calorific value of 540 B.Th.U.; the steam being at 12 lbs. pressure.

With coals containing a high percentage of slack, I found that the capacity for steaming had considerably fallen, so that a steam pressure of 3 lbs. was the maximum permissible. This, I concluded, was due to the *physical condition*, or reduced porosity of the charge, which interfered with the soaking in, or the thorough absorption of, both the temperature and the steam.

Limit of Steaming.—The limit of steaming will, of course, be decided by the quality of the yield; but, in practice, I found no great difficulty in regulating the steam to the capacity for steam of each particular coal, as, to the experienced carbonizer, there are signs, such as the consistency of the charge felt on probing, and the temperature of the off-take pipes, which give good guidance, though analyses of the yield undoubtedly would be the more scientific.

Position of Steam-Inlet.—At Hebden Bridge the position of the steam-inlet was above the extracting mechanism, so that the energy of the issuing jet of steam might be turned to useful account in forcing the steam throughout the cross section of the charge, for the better intermingling of steam and coke; and, moreover, by this method, the hot steam met the hot coke, and there was less condensation on the ironwork, and on the cooled coke in the receptacles.

Superheated Steam.—The steam-pipe was led through a long main flue, to thoroughly dry and superheat the steam by utilizing the waste heat from the setting, and thereby assist in increasing the efficiency of water-gas production.

Length of Retort.—The length of my retorts was 25 ft., which is longer than the Macclesfield retort. It is probable that the length of retorts, where steaming to a calorific standard is intended, can be with advantage increased.

Carbon Porosity.—At Hebden Bridge, the carbon always has been porous; and, since steaming has been continuous, it must, according to Mr. Blundell, have furnished some of the carbon content of the water gas, though this is open to some question, seeing that the formation of water gas is supposed to take place in the lower end of the retort, where at Hebden Bridge little carbon adheres, while the carbon is porous at the top end of the retort.

Steaming Intermittent v. Continuous Vertical Retorts.—The two processes of steaming continuous and intermittent retorts are very similar. For example, when visiting different systems of vertical retorts in 1911, with a view of ascertaining which system would be most suitable for adoption at Hebden Bridge, among them I saw a British intermittent system at Cleethorpes, and witnessed the following experiments: The charge was fully carbonized, without admission of steam. The top lid was opened; and the tar deposit allowed to burn itself until there was left only a small blue flame in the top mouthpiece. Steam was then admitted at the bottom mouthpiece, and a large volume of luminous flame burned at the open top mouthpiece; thus showing that the steam-generated water-gas rising through the carbonized charge had some power of liberating imprisoned volatile matter from the incandescent coke, which I conjecture is precisely the action taking place in continuous vertical retorts.

Carbonizing Temperatures.—Much misunderstanding prevails about the question of carbonizing temperatures. The carbonizing temperature proper is that temperature to which the mass of the charge has been raised, and not, as is often stated, the pyrometer readings of the flues.

In the continuous retort, the charge always moving downward, it follows that its temperature bears some relation to:

The outside flue temperatures, and the conductivity of the retort walls.
The speed of descent.
The physical property of the particular charge.

Since, whatever the arrangement of heating-flues, the charge cannot lose heat on its downward journey, it must of necessity gain heat; hence with all systems of continuous retorts, the hottest cross section of the charge will be found at the bottom of the heated portion of the retort. Therefore, it would appear that capacity for steaming does

not directly bear on high temperatures applied to the bottom of continuous vertical retorts. For example, in the papers, the applied temperature is stated at 1400° C. at the base of the retorts. Had a plan of the Macclesfield setting been given, it would have been apparent that the horizontal combustion chamber heats a series of retorts, and the heating gases could not both enter and leave the chamber at 1400° C. Hence an average figure considerably lower is really operative, or one much more comparable with the 1200° C. prevailing at the bottom of the retort at Hebden Bridge.

Open Furnace Door.—At Hebden, being short of draught, and to cut out resistance, I actually worked for a long period with the clinkering-door to the step grate open. I, however, gave it up in order better to steam the fire for the reduction of clinker formation. The virtue of the "open door" lies in working at the minimum vacuum for the particular setting, which statement has been so often repeated as to be almost an axiom of good carbonization.

Inert Gas Content.—Mr. Blundell claims to work the setting at a pressure; and Mr. West worked the retort at a pressure. It seems that the former will tend for any slight leaks in the retort to increase the inert content, and the latter to reduce the yield. At Hebden Bridge, the retorts were controlled by the retort-house governor to a slight pull, and the setting had a greater pull at the top of the retort, so that the yield was maintained, and the inward leakage rendered impossible.

Calorific Standard.—The writers both recommend a fixed calorific standard, while even in their papers a range of nearly 100 B.Th.U. is shown. But would it not be better for gas to be sold as B.Th.U., so that the producers could, within defined limits, produce the most economical gas for their particular coal and conditions; and the buyer would pay for the heat units obtained. Thus economy would be allied to fairness.

Conclusion.—In conclusion, I would venture the opinion that, just as the incandescent mantle, by rendering needless the high-candle gas, ushered in the vertical retorts, so will the calorific standard, by permitting the high yield of blended gases from vertical retorts, give the necessary saving in first cost of installation, to warrant the more general adoption of this most scientific principle of carbonization.

Sheffield, Nov. 16, 1917. ERNEST J. WELLENS.

Southern Association Discussion on Mr. West's Paper.

SIR,—Referring to my paper read on the 8th inst. before the Southern District Association of Gas Engineers and Managers, I should like to say that, on account of the shortness of time, the President requested me to take only half-an-hour in the reading of the paper, although one hour was required to do it satisfactorily. The President also requested the speakers to be as brief as possible, as there were a large number of members who wished to take part in the discussion.

Mr. Doig Gibb, of the Ministry of Munitions, was the first speaker. He at once said that he had not had time to prepare to discuss the paper, but would leave it to others. To my surprise and astonishment, he disregarded the request of the President, and read a large amount of matter which had no relation to the paper, but was an account of what the Ministry of Munitions had done, which, to the majority of the members, must have been ancient history. Mr. Gibb referred to a letter of mine published in the "GAS JOURNAL" last August, and which he states was based on what, through no fault of my own, was an imperfect knowledge of the then requirements and aims of the Ministry. This statement is absolutely incorrect, and should not have been made, as I was at that time in touch with the Naval Departments, and was fully conversant with the requirements of the Government. He also stated that he was still of the opinion that lower temperature carbonization would result in an increase of the residuals required by the Government, "but at a price." He did not furnish any proof as to how it was possible for low-temperature carbonization to increase the residuals. My remarks in the letter in question were based on actual facts (not theories); and I did not study the question of cost when pointing out to the authorities the fallacy of trying to obtain a quantity of tar so urgently required by reducing the temperature of carbonization, and by carrying out the ill-considered and impracticable instructions issued to the gas industry by the Ministry of Munitions. It appears to me that the fact had been overlooked by them that the lowering of temperautre would materially reduce the output, and would therefore defeat the very object they had in view; for immediately I pointed out this fact to the "powers that be," they saw the defect, and very promptly and fortunately withdrew the scheme.

Mr. Gibb asked whether it was right that double and treble labour was required for low-temperature carbonization. I may point out that I was stating actual facts of what it had cost us. If the speaker had looked carefully into the figures, he would have seen that, with high-temperature carbonization, we produced 60,011 c.ft. of gas per retort in 24 hours, and with a medium temperature only 29,685 c.ft., which is less than half. It would, therefore, take fully 48 hours at medium temperature carbonization to equal the results that are obtained by high-temperature carbonization in 24 hours. This would mean not only double cost in labour, but also double cost for plant. I contend that capital and labour are the stumbling-blocks in the way of low-temperature carbonization, which will prevent such a process being carried out as a commercial success.

Mr. H. O. Carr, of Wandsworth, asked some very proper questions, but time would not allow for a reply. I now give further particulars on the important matter that he raised. The amount of benzol, toluol, and paraffin contained in tar made from vertical retorts varies according to the temperature employed, and the class of material carbonized; and similar variances are noted with regard to horizontal retort practice. Taking a number of tests which have been made on vertical retort tar, it is found that the average of these results shows that the tar contains 0·7 p.c. of benzene, 0·3 p.c. of toluene, and 0·3 p.c. of paraffins. In tar made from the carbonization of coal in horizontal retorts, an average result is approximately 1·4 p.c. of benzene, 0·5 p.c. of toluene, and a slight trace of paraffins. I also give the approximate amount of toluol and benzol per 12,000 c.ft. of gas from vertical retorts, as well as from horizontal retorts.

Vertical Retorts. Per 12,000 c.ft. of Gas.		Horizontal Retorts. Per 12,000 c.ft. of Gas.	
Toluol. Lbs.	Benzol. Lbs.	Toluol. Lbs.	Benzol. Lbs.
1·6	4·5	4·0	9·0

Although vertical retorts give less hydrocarbons of the benzene series and more paraffins than the horizontals, it must not be forgotten that a larger quantity of burning oil can be procured by the verticals than by the horizontals. The figures were given by Dr. Colman in the ratio of 7½ gallons to 3 gallons. These figures I can substantiate.

Mr. G. M. Gill supported my contention that something should be done at once to protect the gas industry against the unwarrantable delivery of inferior coal. He produced definite statements of facts respecting the extra costs occasioned by the abnormal ash content of the coal. I was impressed by his remarks with reference to inert gas; and his statement that the South Metropolitan Gas Company are keeping to a 12 p.ct. limit. I may say that the Press are upsetting the minds of the consumers in the Northern District; and I am of opinion that something should be done quickly to allay their suspicion.

I have been asked to give an opinion as to what I consider would be a fair and workable restriction to impose on gas undertakings with regard to inert gases. In vertical retorts the restriction of 10 p.ct. of nitrogen and carbonic acid could be worked to, but horizontals and inclined retorts could not work to this figure. Several gas engineers with whom I have discussed the matter consider that they would be able to keep within a 12½ p.ct. limit. I was therefore very pleased to hear Mr. Gill practically confirm this amount. I consider, however, that gas undertakings should have a margin of (say) 1½ p.ct. for contingencies; and I think that, if the inert matter is kept within (say) 14 p.ct., it should be satisfactory to all parties. JOHN WEST.

Southport, Nov. 15, 1917.

Separately Generated Blue Water Gas v. Blue Water Gas Made by "Steaming" Verticals.

SIR,—I have been greatly interested in the recent articles and references in the Technical Gas Press on the subject of steaming vertical retorts, and also on the admixture of separately generated blue water gas, including Mr. John West's excellent paper read before the Southern District Association.

Steaming will certainly be widely adopted in present circumstances as a method of cheapening gas production, but will, I think, eventually be found to have been a passing phase in nearing the goal of complete coal gasification. As one who has recently had the opportunity of supervising experiments with steaming continuous vertical retorts and alternatively mixing separately generated blue water gas with good quality coal gas, I would like to lay a few of my deductions before your readers, particularly as, having worked both methods, I may claim to be as unbiassed as is possible.

When vertical retorts are working at as high a temperature as is expedient, having regard to cost of upkeep, the speed of the coke extractors is so regulated that the coke coming out is completely carbonized, and any increase of speed gives incompletely carbonized coke. The retort is then giving its maximum throughput for the coal in question, and the end of the coal core comes very low down in the retort. Steam passed into such a retort, even if very highly superheated, gives a coal gas with a large CO_2 content, and much of the steam passes through undecomposed, presumably finding a passage through the cold coal core.

Two disadvantages then apply—viz., firstly, having to increase heats and, secondly, to reduce the throughput of the coal through the retort in order to give a deeper bed of hot coke for water-gas making, which causes a deeper fuel consumption for a smaller coal throughput. These factors are material to those works carbonizing clean nut coal, and thereby obtaining a large coal throughput, but are more serious still at works carbonizing coal containing much slack, which involves a lower throughput under even ordinary conditions.

Another point is that in the normal working of vertical retorts the carbon decreases in thickness from top to bottom; that at the lower end being often only just sufficient to seal any cracks in the jointing. When steam is passed through the retort, a point is reached—in some cases very quickly—when the carbon is burnt off quicker than it is deposited at the lower end of the retort, and the retort remains in a leaky condition; furnace gases being either pulled in or gas lost. Again, a vertical retort externally heated cannot be justified as an efficient generator of blue water gas from the standpoint of thermal efficiency; this type of generator having been discarded long ago. It is good economy to use as much as possible of the waste heat in the coke in decomposing steam for water-gas manufacture; but it is obviously a retrograde step to apply more external heat solely to obtain an additional make of water gas.

The advantages which undoubtedly have been gained by steaming continuous retorts are probably due to the following facts:

1.—The coal is carbonized at a higher temperature.
2.—Part of the waste heat in the coke is used up in decomposing steam, with production of water gas.
3.—These hot gases passing over the coal help to carbonize it.
4.—Larger tar and sulphate yields are obtained owing both to the prevention of decomposition, as the products are hurried away from the heat zone, and to secondary reactions.

As regards the mixing of coal gas and blue water gas separately generated, nothing more need be said than that, with proper supervision, it presents no difficulty, and gives a gas having a very regular calorific value and a minimum of incombustibles, and minimizes the drawbacks resulting from steaming. One volume of blue water gas can be added from every two to three volumes of coal gas (made without the slightest overpulling).

Comparing the two methods, points of extreme importance are—that the total output is greater when mixing separately generated blue water gas, and the capital cost per 1000 c.ft. of gas made is

less. But, on the other hand, the important advantage of increased tar and ammonia production are lost. Dr. Perkin's experiment, in which, by passing stripped gas through the retort, he obtained an increased make of gas per ton, a larger yield of tar, and probably of ammonia, gives a rational method of procedure in which we combine the advantages of the two systems. Let us make our blue water gas in the most efficient apparatus—viz., a properly-designed generator, and such plant, if not of the self-steaming type, to have its steam generated in waste-heat boilers on the waste-gas flues of the vertical settings (a fan will probably be necessary to maintain the requisite pull on the settings).

If this blue water gas, superheated if necessary, be passed through the retorts, the following advantages should, I suggest, be obtained—viz.:

1.—An increased yield of coal gas per ton of coal carbonized.
2.—The reduction of the CO_2 in the water gas to CO.
3.—No increased heats necessary.
4.—The same increased yield of tar and ammonia as with steaming.
5.—Any carbon would be burnt away very slowly indeed.
6.—Possibly an increased throughput.

The last statement is, I think, justified by the fact that the heat of the coke is not used-up in decomposing steam, and only slightly used-up in reducing the small percentage of CO_2 present. It must, therefore, be chiefly taken up by the water gas passing over it; and this highly heated gas passing through the coal would accelerate its carbonization.

In conclusion, I feel convinced it is more economical and a sounder policy to add separately generated blue water gas, as suggested, rather than to "steam" vertical retorts. Obviously, "steamed" vertical retorts must cost much more in upkeep, by reason of the higher heats necessitated, than "unsteamed" verticals. As is well known, however, under war conditions the installing of water-gas plants is not feasible; therefore, gas-works not already having water-gas plant available should by all means "steam" their vertical installations as the next best thing to separately generating blue water gas.

Nov. 15, 1917. CHAR.

Meter-Rents.

SIR,—Having had the question of the charges for the use of meters under consideration for some time, I was interested in the letter appearing in your last issue over the *nom-de-plume* of "Fairplay-all-Round;" and I hope, with him, that the matter will be fully discussed in your columns, for it is of considerable importance.

No doubt the suggestions of your correspondent would partly meet the difficulty where no meter-rents are charged at present. I think, however, he is incorrect in stating that "meter-rents have been practically abolished by all gas undertakings." A glance at the Board of Trade returns will, on the contrary, show that by far the greater proportion of the gas undertakings throughout the kingdom continue the charge. And is it correct to say that "in normal times to go back to a charge for meter-rent would be a retrograde step"? I would suggest that, both in normal times or at the present time, it is in the interest of both the undertaking and the consumer that rent should be charged. The second and penultimate paragraphs of your correspondent's letter appear to supply the arguments for its retention.

Every undertaking has expended a considerable amount of capital on the provision of meters; and unless a suitable direct return is obtained by way of rent (covering interest, depreciation, and repair), it is obvious that the charge for gas must be higher than it otherwise would be. The result of "free meters" is that the greater the consumption of gas by a consumer the larger the contribution (indirectly) toward the cost of providing measuring apparatus. In other words, the small consumer is put on better terms than the large one!

Several undertakings have to my knowledge already increased their pre-war rents; and, provided the additional charge is reasonable, such action, in my opinion, is justified. Meters cost nearly 100 p.ct. more than they did five years ago; and I think we may assume that prices will never return to the old figures.

If the industry could arrive at a decision as to what percentage on the cost of the meter would cover interest, depreciation, and repair under the altered circumstances (including the question of the shortened guarantee period), it would be of great service.

W. H. BENNETT,
General Manager, Redhill Gas Company.

Gas Offices, Redhill, Nov. 16, 1917.

REGISTER OF PATENTS.

Automatic Controlling Means for Heating and Lighting Installations.—No. 109,333.

SAUNDERS, S., of Manchester.

No. 15,087; Oct. 24, 1916. No. 718; Jan. 15, 1917.

This combined invention is of the class that employs alarum clocks capable of being set, whereby, when the alarum spindle moves, mechanism is released or actuated which (through weights or otherwise) operates dampers, switches, valves, &c., for the automatic performance of some particular office.

To carry out his object, he preferably arranges to act on the mechanism which stops the alarum wind-spindle immediately it has performed its function and effected release. The way of doing this would vary according to the form of stop-alarum appliance. For instance, in that class of clock where a push-down spindle exists, a pivoted lever would form simple actuating means.

The use of time recording mechanism for performing a service automatically at intervals over a period of days has, he points out, been hampered by inability to miss a day or number of days and yet to be able to bring the mechanism into action after skipping a period. As an example, when dealing with automatic heating or lighting or other controlling means, it is obvious that, in the majority of cases, one must be able to suspend action on Sundays without interfering with the due performance of the desired office on the Monday. He can arrange that a day or days may be cut out or omitted by the mechanism; and the simplest way of effecting this part of the object is to make the "release lever" inoperative, when desired, but by means which make such release lever again automatically operative after being out of action for any desired length of time.

Obtaining Coke and Bye-Products from Coal. No. 109,523.

BOSTAPH, H. P., and the BOSTAPH ENGINEERING COMPANY, of Detroit, Mich., U.S.A.

No. 15,478; Oct. 30, 1916.

In accordance with this invention, the coal is subjected in relatively thin masses to a comparatively low, but gradually increasing, temperature, so as "to cause the distillation to progressively proceed from one long edge of each thin mass of coal toward the other long edge, at which latter point the gases of distillation have free escape." The escape is facilitated by subjecting the coal during the coking process to subatmospheric pressure conditions, whereby the temperature in the distilling operation may be sufficiently low to prevent any harmful effect upon the volatilized products.

The coal during the process of coking, and while under subatmospheric pressure, is first subjected to a temperature of about 700° Fahr.—finally increased to about 1000° or 1100° Fahr., in accordance with the coal being treated, although with some coals the maximum temperature may be as low as about 900°. Since the coal is first heated at the exterior or peripheral portion, the patentees point out, distillation and coking begin at such peripheral portion, and the coked material acts as a heat insulator requiring the raising of the temperature to an injurious or undesirable degree if the distillation and coking are to proceed solely by heat conducted through the previously coked portions. But by dividing the coal into relatively thin masses separated by webs of material of heat-conducting qualities superior to the coke, the heat is conducted by the webs past the sides of the coked portions at the periphery and acts progressively along the sides of the thin masses of coal. The distillation and coking therefore proceeds uniformly towards the edge of each thin mass of coal that is remote from the edge first affected by the heat without any necessity of unduly heating the peripheral portion of the subdivided mass of coal. Tapering each thin mass of coal from the outer toward the inner edge contributes to this end; for the mass to be heated decreases in proportion to the distance from the periphery.

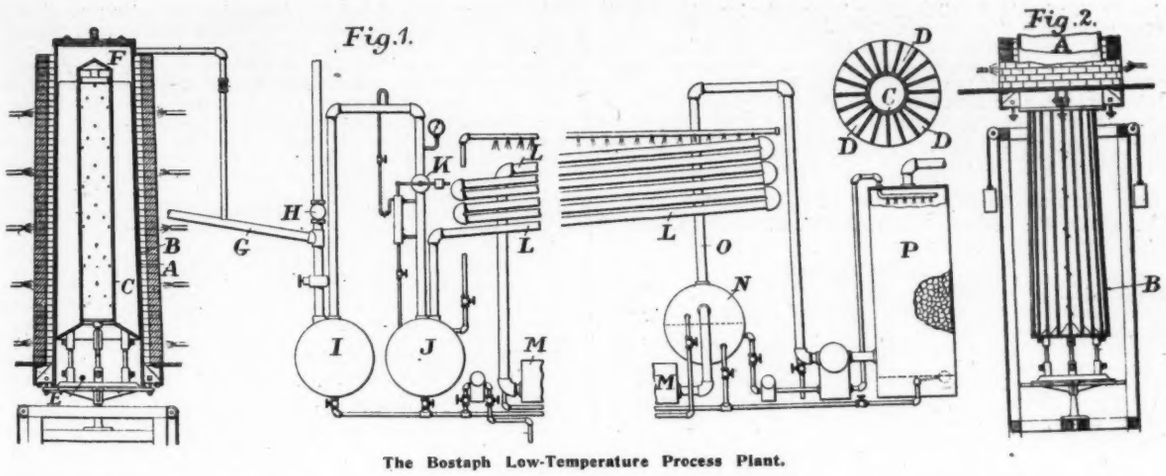
This progressive distillation not only insures the final uniform heating of the whole mass by distributing the heat by conduction, but prevents the sealing or trapping within the mass of any of the volatile products; for the latter are always provided with a ready avenue of escape toward, and through, the inner or thin edges of the coal masses. As the coking progresses, the escaping volatile products are never forced to pass through coked portions of the mass, or a portion of the mass which is at a higher temperature than that at which the volatile products are evolved.

Fig. 1 shows, partly in elevation, partly in section, and partly schematically, the apparatus with which the invention may be practised. Fig. 2 is a view partly in elevation and partly in section showing the core of the retort of fig. 1 lowered, with a cross-section of the core itself.

Mounted upon the upper face of the head of a shell A is a core B, comprising a frusto-conical bottom plate from which rises a tubular duct C having webs radiating therefrom toward the inner wall of the shell into close relation thereto. The tapered core, when in the retort, divides the interior into a circular series of chambers D constituting coal-tubes extending longitudinally of the retort and grouped in circular series about the duct, with which latter each chamber communicates along its inner long edge by way of numerous perforations. With the webs radial, the tubes D are of segmental form, having the widest end at the retort shell; and the chambers are of such dimensions that their greatest width, measured circumferentially of the retort, does not exceed 4 in., and may with advantage be even less. With a commercial form of retort, about 9 ft. long, the core is about 7 ft. in length, having a diameter at the upper end of about 23 in., and at the bottom of about 27 in. The walls of the retort are approximately an inch thick; while the walls of the duct and the webs are approximately ¾ in. thick. In a retort of this size, the coal tubes at their greatest circumferential width are a little less than 4 in., and have a radial depth varying from about 6 in. at the upper end to about 8 in. at the lower end.

In working the invention the core B is lowered from the retort from time to time for the discharge of its contents, by suitable mechanism working with counterweights so arranged as to overbalance the carrier and the core, but so that the counterweights are themselves overbalanced when the core contains a charge of coal or coke. Since there is some liability of the hot coke (because of its expansion) sticking to the core, or even to the inner walls of the retort, the latter is entered by a steam-pipe E, whereby the charge within the retort may be somewhat cooled down before the core is lowered—thus causing a sufficient contraction of the coke to loosen it from the wall.

The duct C opens at the upper end into a chamber F in the upper end of the retort, from which there leads a pipe with a controlling valve connected to another pipe G, which may be common to a battery of retorts and constitutes a vapour line discharging into another pipe (on one side of a release valve H) connected through a valve to a tar-tank I discharging into a condenser drum J. The pipe includes a tar-extractor K, and has connected to it an equalizing valve. Leading from the condenser drum is a pipe connected to one end of a condensing coil L, having associated with it a cooling water spray pipe. The further end of the condensing coil is connected to a washer M discharging into a separating tank N, which communicates with a vacuum pump O discharging into a scrubber P, from which leads a pipe to the storage holder.



The Bostaph Low-Temperature Process Plant.

Cannel coals treated by the present invention are said to produce a smokeless fuel burning with a long flame, and useful for steam as well as cupola purposes. The quantity of oils obtained ranges from two to two-and-a-half times as much as that obtained from bituminous coal; and "the oils are somewhat more highly saturated with acids." The coke has a similar appearance to wood charcoal, but is much firmer and cleaner.

The evolved gases, being quickly carried away through the numerous small openings distributed along each coal-tube—say, at distances of about 6 in. from each other—are not burned; and hence, when treated by a series of condensers, washing apparatus, and cooling coils, subjected during the entire process to a relatively high vacuum, "the character of the recovered bye-products is markedly superior." Because of the treatment of the coal to gradually increasing temperatures within about the limits stated, unusually large quantities of light oils and gases are claimed to be obtained. The entirely different natures of the oils and acids obtained by the process from those obtained at higher temperatures is attributed by the patentees to the fact that the temperatures are not allowed to become excessive. The coke produced retains all the fixed carbon which the coal originally carried.

As an example of the actual practice of the invention, certain cannel coals treated showed by analysis:

Moisture	2·20
Volatile matter	47·35
Carbon	42·15
Ash	8·30
Sulphur	1·30

An analysis of the coke showed:

Volatile matter	11·27
Fixed carbon	74·44
Ash	14·29
Sulphur	1·31

Out of 1200 lbs. of coal there were obtained 854 lbs. of coke and 33 gallons of crude oil condensates of dark brown colour, with a specific gravity of ·995 at 15·5° C., and flowing freely at 27° C.

Benzol Extraction Still.—No. 110,413.

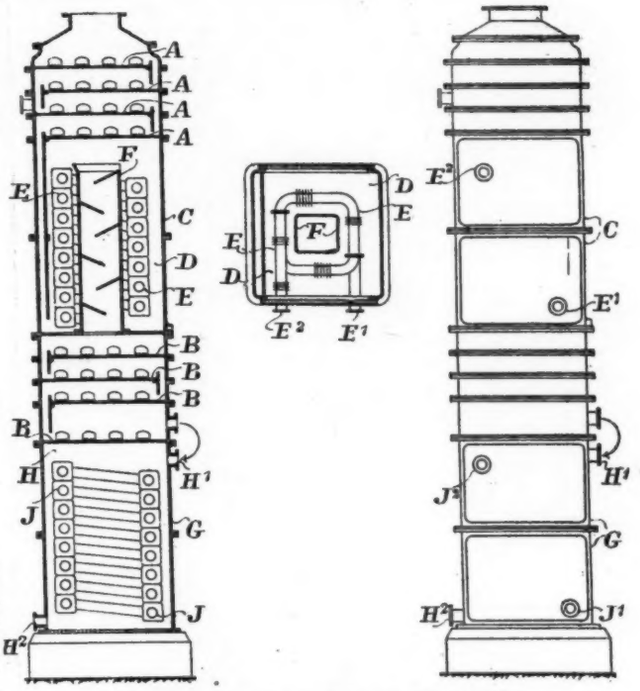
SIMON-CARVES, LTD., and BROWN, J. H., of Manchester.

No. 15,390; Oct. 28, 1916.

It is now the usual practice, the patentees point out, to treat gas liquor, gas-washing oils, and other liquids to be freed from absorbed products or gases—such as benzol, toluol, naphtha, &c.—in continuous column stills fitted with a number of bubbling trays. The saturated absorbent or wash-oils ("rich" oils) must of necessity be heated as far as possible above the points of gasification of the absorbed products before being passed into the still—live dry steam being allowed to enter the base of the still to carry off the gasified or separated absorbed products. It is manifest that if separation of the absorbed products is to be effected by distillation pure and simple, the temperature of the rich oil at the outlet of the still must be above the boiling points of the absorbed products. During the passage of the rich oil through the still the temperature falls considerably owing to: (1) The loss of heat due to plant radiation losses and the reduction in bulk, and (2) the loss of heat due to the latent heat consumption in converting the absorbed products from the liquid to the gaseous state. The fall in temperature due to the consumption of latent heat in gasifying the absorbed products far exceeds, and is of much greater importance than, all the other heat losses.

With existing types of column stills it is impossible to store up in advance, by pre-heating the rich oil, the necessary amount of heat to satisfy the demands for latent heat and provide for the other heat losses and at the same time maintain the temperature of the rich oil at the outlet of the still above the boiling points of the absorbed products. Separation of these absorbed products, therefore, is not effected by distillation pure and simple; it is effected partly by distillation and partly by volatilization or vaporization. The latter operation can be effected irrespective of temperature, and is more correctly referred to as carburetting. In actual practice, after the first tray of the still, distillation decreases and carburetting commences, until at the last tray carburetting alone takes place.

The present invention has for its object to overcome certain difficulties and objections to working such plant, and is especially applicable in the extraction of benzol, toluol, &c., from coal gas, for debenzolizing the oil with which the gas is washed to absorb the benzol, &c. It consists in preliminarily heating the absorbent oil to a temperature above the boiling point of that of the product having the highest boiling point, passing the heated rich oil through a column still, and subjecting it as it passes through the still to re-heatings at the points where its temperature falls to such an extent as to prejudicially affect the separation of the absorbed products by distillation and/or lead to emulsification of the absorbent or rich oil. By so re-heating the rich oil the separation of the absorbed products can, it is said, be effected wholly by distillation much more quickly, and with a less number of trays in the still, than usual, and emulsification of the oil is entirely overcome.



Brown's (Simon-Carves Company) Benzol Still.

One form of continuous column still suitable for carrying out the process is illustrated in central vertical section, elevation, and plan.

The still comprises an upper block of four trays A, a lower block of four trays B, and an intermediate or intervening re-heater C, which consists of a chamber D containing a steam-coil E in the axis of which is arranged a splashing cascade F, the wall and baffles or shelves of which receive a considerable amount of heat by conduction from the coil and also from the steam ascending the still. The steam flowing through the coil enters at E^1 and leaves at E^2.

The rich oil, pre-heated to a temperature of 130° to 140° C. as usual, is delivered on the top tray of the upper block of trays and passes to the second, third, and fourth trays in the ordinary way. As hitherto, the greater proportion of the absorbed products is liberated on these trays, and the temperature of the oil in consequence falls very rapidly and considerably below the initial temperature. At the outlet from the lowest tray the temperature of the oil will probably not exceed 105° to 108° C., and will therefore be below the boiling point of the absorbed naphtha, and very little above the boiling point of the absorbed toluol, though to a greater extent above the boiling point of the benzol.

From the lowest tray the oil passes to C, wherein it is re-heated by the coil E to (say) the initial preheat temperature. The oil rises in the chamber D to the top of the cascade, and passes through the latter to the lower block of trays B, whereon the remainder of the absorbed products is liberated.

From the lowest of the B trays the debenzolized oil passes to a heat

exchanger G, wherein the oil serves to heat-up the incoming rich oil flowing to the preliminary heater. This exchange of heat assists in the cooling of the debenzolized oil and effects a saving of from 30 to 50 p.ct. of the heat that would be otherwise lost. The heat exchanger consists of a chamber H to which the debenzolized oil flows (entering at H^1) after leaving the last of the lower block of trays, and in which is arranged a coil J, through which the incoming rich oil flows on its way to the preliminary heater. The incoming rich oil enters at J^1 and leaves at J^2. The debenzolized oil is drawn off at H^2.

Manufacture of Toluol.—No. 110,448.

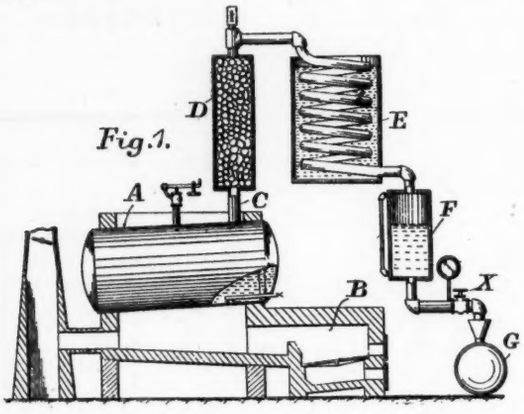
THUMAN, F.; a communication from W. H. GARTLEY, of Philadelphia, U.S.A.

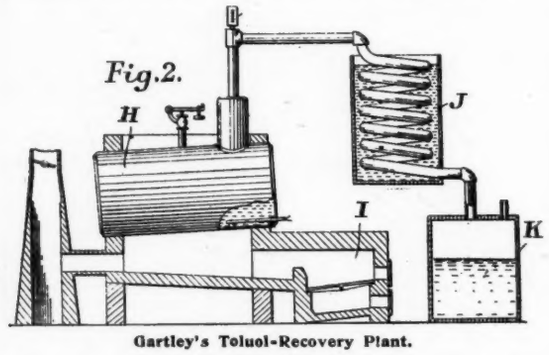
No. 18,270; Dec. 20, 1916.

The principal object of this invention is to obtain an increased percentage of toluol from gas tar, street drip, and similar liquid hydrocarbons resulting from gas-making processes.

The specification points out that in processes of gas making the temperature rises, in some instances as high as 2000° Fahr. or more, with formation of a hydrocarbon series infrequently encountered in the refining of oil whether of paraffin or asphalt base. The ordinary fractional distillation at atmospheric pressure of gas tar and similar hydrocarbons gives rise to products of which three are commercially identified as light oil, dead oil, and pitch. The ordinary fractional distillation at atmospheric pressure of light oil gives rise to products of which three are complex, but are commercially known as crude benzol, crude toluol, and the crude tar naphthas.

It is found, according to the present invention, that the content of toluol ordinarily obtained from coal tar by fractional distillation can be increased approximately from 3 to 15 p.ct. by subjecting the naphthas directly to distillation under a pressure greater than 35 lbs. to the square inch. The distillate in such circumstances (owing to decomposition in the still) comprises toluol; the residue in the still having a boiling point and specific gravity somewhat greater than the untreated naphtha, which residue can be distilled at atmospheric pressure, yielding as distillate a substance resembling naphtha that can be treated similarly to the original naphtha for the production of further toluol, or for such purpose can be added to an original naphtha charge. These steps can be repeated as often as desired, or until the recovered toluol is insufficient to warrant the repetition. The crude toluol obtained can be added to the crude toluol already produced by the old method; the final residue in the still consisting of coke, or at least a very heavy residuum.





Gartley's Toluol-Recovery Plant.

Fig. 1 is a side view (principally in section) illustrating a pressure still, and fig. 2 is a similar view of an atmospheric still.

In fig. 1, A is a still; B, a furnace; C, a vapour pipe; D, a dephlegmator which should be provided with a "planer" or suddenly-acting condenser for condensing and returning to the dephlegmator vapours of higher boiling point that might otherwise be carried off with the vapours of lower boiling point; E, a condenser; F, a receiver; and G, a shipping drum. In fig. 2, H is a still; I, a furnace; J, a condenser; and K, a receiver.

Naphthas of the kind referred to are put into the still, and a fire is started in the furnace. The pressure in the still, as soon as vaporization commences, is maintained at about 35 lbs. per square inch; and the result is to confine in the liquid vapours that otherwise would have been set free at the temperature of the liquid in the still. During the process the temperature of the liquid increases; but when, under the pressure of 35 lbs. per square inch, the temperature of the liquid in the still arrives at about 260° Fahr., destructive distillation proceeds with a change of the molecular composition of the naphthas and with the evolution of gas, crude toluol, and the deposit in the residue in the still of the carbon set free. As the temperature rises, this production of crude toluol, due to the breaking-down of the molecules of the naphtha in the still, continues until the temperature rises to about 460° Fahr., always maintaining the same pressure. The distillate (crude toluol) is collected in the drum G. The valve is a means for creating and maintaining the desired pressure, and a thermometer, pressure gauge, and pyrometer are provided for ascertaining the conditions that exist in the still and its accessories. There is left in the still a residue which is somewhat heavier than the naphtha—a residue which is transferred from the still A to the atmospheric still H (fig. 2) and is subjected to distillation at atmospheric pressure. The distillate collected in the receiver K resembles naphtha, but is somewhat heavier. The residuum in K is coke; or if the distillation is not carried far enough to result in coke, it is a very heavy residuum. If desired, the distillate from K may be put back into the still A and again subjected to distillation so as to produce more toluol, and more of the described residue, which can be treated in the still H as described. These steps can be repeated until the recovery of toluol is insufficient to warrant the operation.

In the pressure still A there is an evolution of gas and a deposit of carbon which indicate a breaking-down or molecular rearrangement of the constituents of the naphtha, which may be called destructive distillation; and the distillation is continued as long as the recovery of toluol warrants. It is pointed out that the naphtha introduced into the still A has a higher boiling point and a lower specific gravity than the distillate obtained from the still, which has a lower boiling point and a higher specific gravity. The specific gravity of naphtha is between ·875 and ·848, and that of the residue about ·886.

It may aid the description to mention that, in the operation of the still A, the naphtha, made up of members of the aromatic series which have formulas C_9H_{10} or C_9H_{12}, is converted into the material which has been referred to as the distillate having the formula C_7H_8. Additionally it may be said that, in the still, there is a conversion of a part of the naphtha into toluol, as well as the production of the residue above referred to, which boils at a higher temperature than the original naphtha. The distillate recovered in the receiver K has a lower boiling point than the residue that was put into the still H.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Nov. 14.]

Nos. 16,076—16,542.

WILLIS, J. H., and WILSON, G. G.—"Supply of fuel for internal combustion engines." Nos. 14,327 and 14,328.

ABRAHAMS, E. G.—"Air-compressors in connection with apparatus for producing gaseous fuel." No. 16,309.

AMES, R.—"Gas-containers for motor vehicles." No. 16,242.

BOYER, J. F.—"Storing gas for use as fuel on motor vehicles." No. 16,415.

BRIERLEY, T. S.—"Gas-containers." No. 16,082.

BROWN, W. F.—See Ames. No. 16,242.

BROWNE, J. G. H.—See Brierley. No. 16,082.

Chrisman, C. S.—"Gas wash-boxes." No. 16,290.

COCKEY, F. C.—"Measuring gases." No. 16,467.

COOPER, B. G.—"Apparatus for evolving gases from liquids." No. 16,108.

CORTHESY, J. H.—"Means to generate gas from coal, &c." No. 16,085.

COX, C.—"Combined gas compressor and container for supplying gas to engines." No. 16,111.

FREW, J.—"Storage of gas." No. 16,360.

GAS METER COMPANY.—"Dry gas-meters." No. 16,466.

GAS METER COMPANY.—"Measuring gases." No. 16,467.

GREGORY, H. H.—"Motor-cars driven by gas." No. 16,541.

GRIFFITHS, E. A.—See Cooper. No. 16,108.

HEYDEN, W.—"Receivers for gas, &c." No. 16,457.

HODGSON, J. L.—"Fluid-meters." No. 16,411.

HOLLIS, B. W.—See Boyer. No. 16,415.

HUDLASS, F. W.—"Automatically regulating supply of gas to engines of motor vehicles." No. 16,306.

JONES, L. J.—See Brierley. No. 16,082.

KILNER, R. R.—"Charging-valves for gas-containers." No. 16,113.

KILNER, R. R.—"Engine installations adapted to run on gas." No. 16,114.

LAMB, J. W.—"Gas-fire lighter and poker." No. 16,331.

LEA, F. M.—"Heating-stoves burning gas, &c." No. 16,236.

LIGGETT, R.—"Gas and air mixing and control valve for internal combustion engines." No. 16,523.

LIGGETT, R.—"Reducing-valves." No. 16,524.

MARTIN, R.—"Gas-producers." No. 16,417.

MOON, P. G. G.—See Boyer. No. 16,415.

MURPHY, S. J.—"High-pressure gas-container." No. 16,144.

PARKER, J. W.—"Air-compressors in connection with apparatus for producing gaseous fuel." No. 16,309.

RITCHIE, H. G.—"Automatically reducing and providing constant pressure of gas in engines." No. 16,498.

ROBINSON, G. H.—"High-pressure gas systems for motor vehicles." No. 16,401.

SOUTHON, J. C.—See Gas-Meter Company. No. 16,466.

SPENCER, G.—"Flexible coal-gas containers for motor vehicles." No. 16,227.

TALBOT, F. W.—"Unions for connecting branch-pipes to mains." No. 16,148.

THUMAN, F.—See *Chrisman*. No. 16,290.

TOFIELD, H. C.—"Brackets for carrying gas-lamps." No. 16,516.

WHITE, J. T.—"Utilization of gas on motor vehicles." No. 16,425.

WILD, J. E.—See Kilner. Nos. 16,113, 16,114.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF COMMONS.

Street and Shop Lighting in Scotland.

Mr. DUNCAN MILLAR asked the Secretary for Scotland whether his attention had been directed to the resolutions passed by Merchants' Associations in towns situated in Lanarkshire and in the West of Scotland as to the insufficient illumination of the streets and of shop windows under the present lighting restrictions during the afternoons and early evenings when the shops are open for business, and whether he was prepared to consider some modification of the Lighting Order, so as to permit of the better lighting of streets and shop premises under an arrangement which would provide for the immediate extinction of lights within a specified period after an air-raid warning had been received.

Mr. MUNRO, in replying, said he had received resolutions of the nature referred to. As to street lighting, revised arrangements had been communicated to chief constables which, it was hoped, would enable increased lighting to be provided. As to shop lights and other private lights, he was at present considering proposals, in consultation with the military authorities, for deferring the hour at which the Lighting Order at present took effect; and he expected shortly to be able to announce a revision of the Order in this direction.

LEGAL INTELLIGENCE.

ALLEGED COAL PROFITEERING.

An important prosecution, the first of its kind, under the Price of Coal (Limitation) Act, 1915, occupied the attention of the Liverpool Stipendiary Magistrate on Friday, when Mr. H. S. Higginbottom and the New Moss Colliery Company were summoned for selling coal at prices exceeding by more than the standard amount per ton the "corresponding prices" under the Statute. There were fifteen summonses.

Mr. GREAVES LORD (who prosecuted for the Director of Public Prosecutions) explained that Mr. Higginbottom was the controlling shareholder and director of the New Moss Colliery. The Act under which the informations were laid was passed in order to prevent profiteering in coal and outrageous prices being charged, both to the general public and industry, owing to circumstances arising out of the war. The Act provided that "coal at the pit mouth shall not be sold or offered for sale, directly or indirectly, at a price exceeding by more than the standard amount per ton the price of coal of the same description, in similar quantities and under similar conditions at the same mine, on the corresponding day in the twelve months of 1914." And a sub-section of the Act said that the "standard amount shall be 4s." It was extremely important that it should be known to everyone that the Government took the view that the Act should be enforced with the utmost rigour. An arrangement had been come to between himself and Mr. Glover, who appeared for the defendants, that, after certain documents upon which the prosecution relied had been put in, the Magistrate should refer the question of prices to the Board of Trade. The first information concerned the offering for sale in September of 5000 tons of screened gas coal to Messrs. Rennick, Wilton, and Co., of Torquay. The contract on which this charge was based was the price of 22s. 6d. per ton at the pit. The corresponding price was not greater than 14s. 6d.; so that the legal price ought not to have been greater than 18s. 6d. It would thus be seen that the defendant proposed to put on 4s. a ton in excess of the legal price. In the second case, the contract, they alleged, was 7s. above the legal price; and in the others the prices alleged to have been charged were 6s., 7s. 5d., and 3s. 9d. above the legal price.

Mr. GLOVER said the great point which would have to be decided in these cases was as to what was the corresponding price. This question must be submitted to the Board of Trade. He was instructed that all the prices charged by his clients had been fully justified; and they were most desirous that the opinion of the Board of Trade should be obtained on the point. If they were excessive, the defendants were quite willing to revise them. A number of questions would also arise on the construction of the Act; and there would be a difficulty in fixing the corresponding price. The summonses would resolve themselves into a test case. Both prior to, and up to, the time of the laying of the informations his clients had afforded the prosecution the fullest and freest access to their books.

The Magistrate adjourned the case *sine die;* the question of the corresponding price to be referred to the Board of Trade.

Theft of Gas Oil.

At the Brentford Police Court, on the 7th inst., John Walker, motor-boat owner, was charged with the theft of a quantity of gas oil, the property of Messrs. Thomas Clayton (Oldbury), Ltd. Mr. Forrester Clayton, J.P. (Managing-Director of the prosecuting firm), stated that they had a contract with the Anglo-American Oil Company, Ltd., for the conveyance of gas oil from Purfleet to the Birmingham Corporation; and, owing to serious shortages having taken place during transit, inquiries were made, and suspicion eventually fell upon the defendant. Walker, who pleaded guilty, was fined £50, £45 restitution, and £3 costs—£98 in all—or three months' imprisonment.

Whittington Gas Charges.—In consequence of the increased cost of coal and labour, the Board of the Whittington Gas Company (Derbyshire) announce that they are compelled to advance the price of gas, from the reading of the meter indexes at the December quarter, by 6d. per 1000 c.ft.

MISCELLANEOUS NEWS.

EFFECT OF THE WAR ON GAS UNDERTAKINGS.

Mr. A. L. Ryde, in his Presidential Address to the Surveyors' Institution, said that, in his judgment, the stability of the figures of assessable value within the County of London was a substantial corroboration of the view that the war would not damage property in Great Britain to anything like the same extent that it would in France, Russia, Italy, Germany, or Austria.

From 1913 to 1917, while the figures of assessable value representing millions were absolutely stationary, the figures following represented a slight but steady increase, with only one setback. The latter was easily explained by the occurrence of the quinquennial re-assessment in the Metropolis in 1915, the effect of which was to show in 1916 a reduction of just under £32,000 on the 1915 figures. It was well known to rating surveyors that, during the revision in question, immense reductions were made in the rateable values of all properties having to depend upon an industry requiring a consumption of large quantities of coal. Gas-works and electric light works obtained very substantial reductions on their assessments—amounting, in the case of the largest property (that of the Gas Light and Coke Company), to the enormous figure of £104,632.

The rateable value of gas-works was already greatly influenced by the gradual increase in the price of coal before the war; and the effect of the war was enormously to increase the cost of the raw material, in consequence of the rise in freights. The Gas Light and Coke Company used in the course of the year 1913 about 2,000,000 tons of coal, most of which came from the Newcastle district, at a freight of some 3s. per ton. In a very short time, the operations of the Germans had the effect of running-up the cost of freight by some 10s. per ton; so that the increase to this one Company amounted to about £1,000,000 per annum—a sum which was sufficient to upset all calculations, and to render it extremely difficult to make both ends meet. The gas companies, however, had two sources of income which furnished a strong recuperative power. They were (*a*) the power to raise the price of gas; and (*b*) the price of coke and other residual products, which always had a tendency to rise in sympathy with the price of coal. It was, of course, a fact that the effect of raising the price of gas was to reduce the consumption; but, in spite of this fact, the power to increase the price, within limits, had an immense effect in giving stability to the annual value of gas-works. It must not be forgotten also that the various companies were manufacturing explosives for the Government in large quantities.

In these circumstances, the effect of the war upon the annual value of gas-works was not so easy to define as it was in the case of railways; but it had undoubtedly reduced the value substantially.

EDINBURGH GAS EMPLOYEES' WAGES.

At a meeting on the 12th inst. of the Works Committee of the Edinburgh and Leith Gas Commissioners, the demand was considered of the men for an additional increase in wages of 10s. per week. It was decided not to concede the demand, but to allow the matter to go to arbitration.

On the initiative of the Edinburgh Corporation, a conference of local authority representatives was held last Wednesday. It was pointed out that each authority acted independently; and those bodies who had granted increases on a higher scale were quoted in support of claims for advances in other districts. These inequalities tended to discontent; and it was considered undesirable that local authorities should outbid one another. While it was generally felt that it was impracticable to decide at this stage on any policy that would affect claims at present pending, the meeting agreed to devise a common policy to be adopted in the future. Among other points discussed was whether a uniform standard wage should be introduced for the various classes of employment, or whether the different Corporations should agree to make uniform advances on pre-war standards in each case.

At a mass meeting of the employees held last Friday, it was decided to stop work on Monday, if the demand for an increase of wages of 10s. per week were not granted. The Lord Provost of Edinburgh, the Provost of Leith, and the Gas Engineer (Mr. Alexander Masterton) met on Saturday the General Secretary of the National Union of Corporation Workers and the Local Secretary, when various misunderstandings regarding the position taken by the two parties in the dispute were cleared up. The Commissioners agreed to an immediate arbitration; and it was arranged with the men's leaders to hold a meeting on Sunday afternoon, when the Lord Provost, with the Commissioners' representatives and the men's officials, would address the meeting. It was hoped that this would result in a mutual agreement to refer the question to arbitration.

West Bromwich and Economy.—Owing to the difficulties that are being experienced, the Chairman of the West Bromwich gas undertaking (Alderman Brockhouse) has made a public appeal to householders to exercise the strictest economy in the use of gas. He points out that no further connections to meet any demands would be made, as the Committee would not be able to adequately cope with the present demands unless the greatest care was taken in the use of gas. There had been another increase recently of 2s. 6d. per ton in the price of coal, due to the advance to the miners; and he hinted at the possibility next quarter of the gas charges being further increased. The appeal is supported by the Vice-Chairman (Mr. A. Vaughan), who advocates the appointment of an inspector to make a thorough investigation into the purchase of gas-mantles, &c., to see that the consumers have good mantles.

A COALITE AGREEMENT.

Low-Temperature Carbonization, Ltd.

In a circular which has been issued to shareholders of Coalite, Ltd., it is stated that negotiations have for some time past been in progress for the exploitation of the Company's patents. An agreement, the chief points of which are set out below, has now been concluded with Low-Temperature Carbonization, Ltd. (of which Mr. F. L. Davis, the President of the Monmouth and South Wales Coal Owners' Conciliation Board, is Chairman), under which the Company is appointed Manager of the business of Coalite, Ltd., for ten years from Oct. 1, 1917.

The Company will receive advances of £6000 in each of the five years commencing on June 1, 1918. Such advances will be repayable only out of the net profits derivable by Coalite, Ltd., from the sale of, or dealing with, its rights and interests by Low-Temperature Carbonization, Ltd.

The Low-Temperature Carbonization Company will be entitled to 50 p.ct. of the net profits resulting from the sale of, or dealing with, the rights and interests of Coalite, Ltd. The general terms of any such sale are to be subject to the reasonable approval of Coalite, Ltd. In the event of default by the Carbonization Company, Coalite, Ltd., will, after proper notice, be competent to determine the agreement.

In the "Westminster Gazette" last Thursday, the following paragraph appeared: Coalite shares have been well to the fore during recent weeks; it being known that negotiations have been proceeding for the exploitation of the Company's patents. The concern was registered in 1906, to acquire inventions and letters patent relating to the production of smokeless fuel. The authorized capital is £106,250, of which £100,000 are ordinary £1 shares and the rest deferred shares of 1s. each. The rights for the United Kingdom were sold in 1907 to the British Coalite, Ltd., in which Coalites hold a substantial interest. An agreement has now been reached whereby the Low-Temperature Carbonization, Ltd., is appointed Manager of the business of Coalite, Ltd., for the term of ten years from Oct. 1, 1917, on the terms referred to above.

Consumers Ask for Appointment of an Examiner.—At Brownhills, last week, Dr. F. Wolverson applied on behalf of himself and four other consumers of gas supplied by the Ogley Hay and Brownhill Gas Company for the appointment of a gas examiner under the Gas-Works Clauses Act, 1871, and asked that Mr. N. W. Cresswell, of Moseley, the Official Gas Tester to the Birmingham Corporation, should be selected. The Local Authority had not appointed a gas examiner. The Clerk said the Magistrates had power, in these circumstances, to make an appointment at the request of five consumers. The Bench made the order asked for.

GAS FOR MOTOR VEHICLES.

Reporting on the subject of the installation at garages of gas-filling arrangements for motor vehicles, the Public Control Committee of the London County Council remark that, as the process of filling may possibly occupy a considerable time, there is risk of inattention on the part of the operator which may result in a serious leakage of gas. They have therefore considered what precautions should be taken to avoid risks from installations fitted-up at premises licensed to store petroleum spirit. It does not seem necessary for the Council to take any action if the gas-filling point is in the open air and at a distance of not less than 20 ft. from the petroleum storage place or filling point; neither does it appear necessary to raise objection to cars fitted with gas-containers being garaged with petrol-driven cars, if the garage is artificially lighted by incandescent electric lamps and is well ventilated at the roof-level. As it is possible that, in the near future, an increasing number of these gas installations may be provided, the Committee are in communication with the owners of garage premises licensed by the Council under the Petroleum Acts, with a view to efficient measures being taken to obviate any risk of accident occurring through the means adopted for filling the gas receptacles or for lighting the premises. They will report, after experience has been gained, as to the general conditions which the Council should impose.

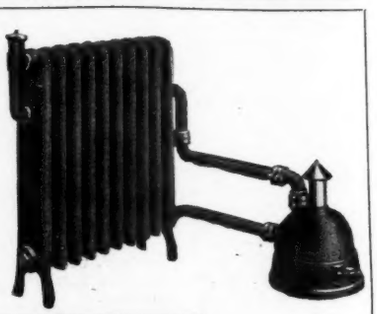
A statement which appeared in last week's "JOURNAL" to the effect that "the Portsea Island Gas Light Company, who supply Portsmouth and the surrounding district, are quite unable to entertain any scheme for the supply of gas for motor vehicles," is, we are informed by the Secretary (Mr. H. A. Stibbs) "quite erroneous." The exact position he explains is this: "The Directors are awaiting, and hope to co-operate in, the co-ordinated scheme which is being considered by the industry as a whole, in conjunction with the representatives of the motor industry, pending which the Company, although not affording any special facilities for filling containers, offer no objection whatever to supplies being obtained for this purpose through consumers' existing meters."

The Yorktown and Blackwater Gas Company are filling gas-containers on motors at their works, which are on the London to Basingstoke Road. The charge made is at the rate of 3s. 6d. per 1000 c.ft., *plus* 6d. filling fee.

A somewhat novel position has been created at Chesterfield in connection with the use of gas-bags on chars-a-bancs which convey workmen to the different collieries in the district. Complaints have been made to the District Council that trees on the estate of Sir George Sitwell which overhang the main road were seriously impeding these gas-driven vehicles, and that in order to escape them it was necessary to go on the wrong side of the road. A resolution has therefore been passed by the Council asking the owner to lop off the trees, and thus remove the obstruction.

Messrs. Andrew Barton Bros., of Beeston, show a photograph of a motor bus carrying passengers daily between Beeston and Nottingham.

THE PATENT "Garajo" GAS-HEATED BOILER



A novel and unique apparatus for effectually heating **MOTOR-GARAGES, GREENHOUSES, LIVING ROOMS, SCHOOLS,** and **ALL BUILDINGS** suitable for **HOT-WATER HEATING.** Simple in construction, easily fixed to existing gas supply. Costs less to buy—less to instal—less to maintain than any other gas-heated hot-water apparatus.

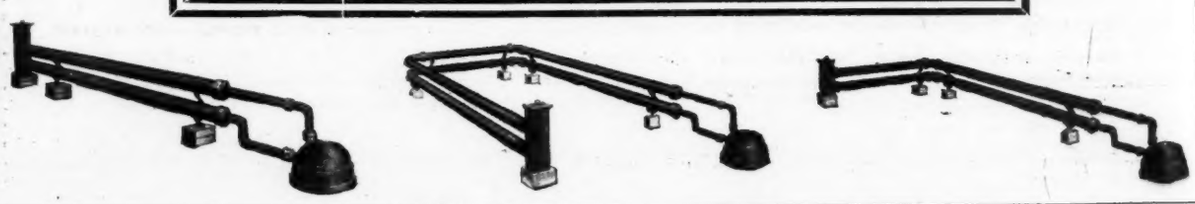
Above illustrations show the "Garajo" connected up to our "Essex" Radiator. For large installations the "B.T.U." Boiler is desirable. Both give reliable service without trouble.

Weatherproof Hutch for enclosing the "Garajo."

Anti-Downdraught Flue Cap.

Please send for full particulars and prices to

JOHN WRIGHT & CO., Essex Works, Aston, BIRMINGHAM.



Working on coal gas has proved highly satisfactory; the container, it is stated, being quite good after fourteen months' use. The firm's 7 to 8 ton gross vehicles travel from 12 to 15 miles on one filling of about 400 c.ft. The filling occupies some three minutes.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Nov.* 19.

In the London tar products market pitch continues in steady demand. Prices obtainable depend considerably upon the amount of freight offering. It is reported that business has again been done at well over 48s. per ton net in bulk f.o.b. makers' works. Solvent naphtha maintains its strength, and makers' price is not below 4s. per gallon net and naked at works, both for prompt and forward delivery. Supplies for near months are scarce. There is a certain amount of inquiry for pyridine bases; and the price to-day is called 4s. 3d. per gallon filled into buyers' drums at makers' works. In other products there is nothing of particular interest to record.

The demand for sulphate of ammonia continues. Practically the whole of the make of the southern counties is being absorbed for home agricultural purposes.

Tar Products in the Provinces.

Nov. 19.

There is nothing fresh to report concerning the market for tar products.

The average values for gas-works products during the week were: Gas-works coal tar, 26s. 6d. to 30s. 6d. Pitch, East Coast, 20s. to 25s. per ton; West Coast—Manchester 18s. 6d. to 19s. 6d., Liverpool 18s. 6d. to 19s. 6d., Clyde 18s. 6d. to 19s. 6d. nominal. Benzol 90 p.ct., North, 10½d. to 11½d.; 50-90 p.ct., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 7¾d. to 8¼d. Solvent naphtha, naked, North, 3s. 2d. to 3s. 3d. Heavy naphtha, North, 1s. 8d. to 1s. 10d. Creosote, in bulk, North 3¾d. to 4¼d. Heavy oils, in bulk, North 4¼d. to 4½d. Carbolic acid, 60 p.ct., East and West Coasts, 3s. 4d. naked. Naphthalene salts, 80s. to 90s., bags included. Anthracene, "A" quality, 3d. per unit; "B" quality, 1¼d. to 2d.

FROM A MARKET CORRESPONDENT.

Tar Products.

During October the value of coal products, not including dye-stuffs, exported from the United Kingdom amounted to £297,580, bringing the total value of such exports for the ten months of this year to £2,666,352. On the other side of the account, 2181 cwt. of coal products, not including dye-stuffs, were imported during October valued at £47,391, bringing the total of such imports for the ten months to 37,758 cwt., valued at £479,306. The general tone of the market for tar products is quiet; the chief feature of the past week being the continued strength of naphthas. Solvent naphtha is again dearer for prompt; and although the demand for deliveries over the first six months of next year is not quite so heavy as recently, a very fair business is being booked at from 3s. 9d. to 4s. 3d. per gallon. Heavy naphtha has further advanced, and now makes 2s. 6d. to 2s. 9d. per gallon. The foreign demand for pitch is still of a satisfactory nature, and the price remains at 48s. per ton f.o.b. London. The Provincial position continues to have an improving tendency, although only small exports are being made at the moment, on account of lack of shipping facilities. No benefit appears to have been felt, as yet, from the arrangement by which pitch may be mixed with fuel oil. Difficulties with regard to blending are said to have arisen which may limit the consumption of pitch for this purpose, for a time at any rate. The general feeling, however, is that the difficulties can be surmounted if pitch remains cheap, and that, consequently, a reduction in accumulated stocks is almost certain to take place in the near future. Naphthalenes are firm at late rates, while a demand is springing up again for cresylic acid at an improved level. Of benzols and carbolic acid, practically nothing is heard; while as regards creosote, the blast-furnace output to the end of the year is wholly taken by the Government, and the gas coal-tar output is not on open offer. Some dissatisfaction is expressed that merchants are not allowed to make any profits on sales which pass through their hands. The range of quotations is as follows:

Aniline Oil (pure): 1s. 2d. per lb.

Benzol: 90% London, 1s. 0½d., North 10½d. to 11½d.; 50% North 1s. 4d. to 1s. 5d. naked per gallon.

Carbolic Acid: 60% East and West Coast 3s. 6d. per gallon; crystals 40%, 1s. 3d. per lb.

Crude Tar: London 28s. to 32s., Midlands 25s. to 26s.; North 26s. per ton, *ex* works.

Pitch: London 48s. f.o.b.; East Coast, 22s. to 25s. f.o.b.; West Coast—Liverpool 21s. 6d. to 22s. 6d.; Manchester 22s. to 23s. f.a.s., Clyde 22s. 6d. per ton.

Solvent Naphtha: Naked London 90-190% 2s. 3d. to 2s. 9d.; North 2s. 3d. to 2s. 6d. per gallon; 90-160% naked London 4s. to 4s. 6d.; North 3s. 9d. to 4s. per gallon.

Crude Naphtha: Naked 30% 8¼d. to 8½d.; North 6¼d. to 6½d.

Naphthalene: Refined £32 10s. to £35; salts 80s., bags included.

Toluol: Naked, London 2s. 4d.; North 2s. 3d.

Creosote: Nominal, London 4¼d.; North 3¾d.; heavy oil, 4¼d. per gallon in bulk.

Anthracene: "A" quality, 40-45%, 4½d. per unit; "B" quality, 1¾d. to 2¼d.

WAR WORK

Has had first place with us since 1914.

We appreciate, however, our customers' needs for "D.S.O." Fires and Gas Steam Radiators. In thanking our many clients for their orders, we would respectfully beg their indulgence if their exact requirements cannot be met at once, and we suggest to save delay that alternate sizes and finishes be accepted where possible.

R. & A. MAIN, LTD.

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.

SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 83, Old Market Street, BRISTOL; 18, Severn Street, Deansgate, MANCHESTER; 97, Millfield, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

Cresylic Acid: 95%, 2s. 7d.; 97-99%, 2s. 8d. to 2s. 9d. *ex* works London and f.o.b. other ports.

Grease Oils 18° Tw. (naked) £6 per ton f.o.r. makers' works.

Sulphate of Ammonia.

Nitrate of soda being now practically off the markets as a fertilizer, farmers are getting more anxious to secure supplies of sulphate while prices remain so favourable. Thus outputs are being well taken up—in fact, the double demand from the agricultural community and from the munition factories seem to be absorbing all available supplies, and the quantity left for export is rapidly decreasing. Last month 3544 tons were exported, compared with 21,675 tons and 22,951 tons in October, 1916 and 1915 respectively, and in the ten months to the end of last month only 54,757 tons were exported, against 212,223 tons and 247,882 tons in the corresponding periods of 1916 and 1915 respectively. The value of October's exports was £68,786, or an average of £19 8s. 6d. per ton. This once again brings the vexed question of export values to the fore. There is a large foreign demand; but the price does not depend on the demand under present conditions. As pointed out on previous occasions, price is governed by political and other considerations and many other matters which cannot be discussed here. Consequently, the difficulty of giving any indication of the real export value is very great indeed. The present month has already produced an extraordinary range of values, as the following will indicate: In the first 14 days, two tons were exported from Liverpool at £45 per ton, 340 tons from Middlesbrough at £17 10s. (roughly), and 338 tons from Leith at under £12 per ton. It is not permitted to publish the names of ports or countries to which exports are destined; but a knowledge of these would probably cause manufacturers to materially modify their criticism of price. At any rate, the matter is hardly worth arguing about, as, owing to the very heavy home demands, it is more than likely that licences for export will be entirely suspended almost directly until the spring. In Australia, the price of sulphate has been fixed at £18 per ton in all States except Queensland, where it is to be £19; while in America trade is pursuing the course previously indicated in these notes, and the price is now becoming easier—£28 per ton being probably an average quotation, against over £30 a few weeks ago.

After considering an application on behalf of over 3000 employees in various Bradford Corporation departments, the War Wages Committee of the Corporation have decided to increase the men's war bonus of 12s. to 15s. per week, and that of the women from 6s. to 8s.

The Redcar Coke-Ovens and Bye-Product Plant have been acquired from the Tees Benzol Syndicate, Ltd., by Messrs. Dorman, Long, & Co., Ltd., of Middlesbrough, who will also take over and complete the whole of the undelivered balances of the sales and purchase contracts entered into by the Syndicate. The business will be carried on under the same management as before.

Wages at Coke-Oven Works.—Colliery owners have received an intimation from the Ministry of Munitions that, in consequence of the recent advance in wages awarded to colliery workers, it became necessary for the department to harmonize with this award the wages in the industries allied to coal mining—coke-works, &c. The principles were agreed upon at a joint meeting.

Progress at Yorktown.—The Yorktown and Blackwater Gas Company have entered into an agreement with the Home Office authorities to supply gas in bulk to the Broadmoor Criminal Lunatic Asylum; and as soon as the necessary mains have been laid, the asylum gas-works will be closed. The Company are to be congratulated upon the fact that this is the third gas-works taken over by them, as they already supply the Royal Military and Staff College at Sandhurst, and Wellington College, Berkshire, both of which had their own gas-works prior to the Company undertaking the supply. As is fitting, Mr. Henry J. Randall (the Engineer and Manager) is prospering with the Company; for the Directors recently granted him a further increase in salary of £50 per annum—this being his second increase during the two years he has been there.

Irish Gas-Workers' Wages.—Belfast gas-workers would have been affected, and considerable dislocation must have arisen, had a great strike of municipal workers materialized, as had been expected, last week. Fortunately, a section of workers held that a strike was unnecessary—just then, at all events. In the absence of complete unity, it was decided that all the men should continue at work. The question of increased war wages has been promised due attention in January, when all such matters come before the Corporation in the ordinary course. The Minister of Labour has been consulted regarding the situation. During last week, Mr. J. M. Whittaker, B.L., sat in Dublin as Arbitrator in the wages question between the Alliance and Dublin Consumers' Gas Company and their employees. His award is expected this week.

South Australian Gas Company.—Dealing with the twelve months ended June 30 the Directors state that the increase in the output of gas has been maintained, and some 18 miles of new mains have been laid. Difficulties in securing materials have, however, so increased that the Board are forced to partially abandon the policy of expansion, by refusing to accept any application for a supply involving an extension of mains. In order to meet the higher cost of production entailed by the increased price of coal, the additional costs of materials, and higher wages granted to the employees in the manufacturing and distributing departments, it was found necessary in February to advance the rates for gas by 6d. per 1000 c.ft. A further advance of 3d. was made in June, owing to increased wages recently awarded to gas employees in the Federal Arbitration Court. This award involved the Company in additional wages to the extent of approximately £9300 per annum, and accumulated retrospective pay totalling £8700. It has been necessary to draw on the reserves to the extent of £2817 for the equalization of the dividend.

IMPORTANT ANNOUNCEMENT!

MESSRS.

R. & J. DEMPSTER, Ltd.,

having found it necessary to make alterations in their London Office, desire to announce they have now installed a

TECHNICAL STAFF in NEW OFFICES at

CONNAUGHT MANSIONS,
34, VICTORIA STREET,
WESTMINSTER, S.W. 1.

Telephone Number: Victoria 7426. Telegraphic Address: "Scrubber, Vic. London."

These alterations will enable them to give prompt attention to all Government and Gas Trade enquiries, and they hope it will prove serviceable to old and new clients.

GAS PLANT WORKS, MANCHESTER.

Increased Price at Brighouse.—The Brighouse Corporation have advanced the gas charges, for the current quarter and until further notice, as follows: Within the borough, to 3s. 4d. per 1000 c.ft., with a discount of 6d. for prompt payment; out districts, ordinary consumers, to 3s. 7d., with a discount of 6d.; slot-meter consumers, at existing rates, but discount is discontinued.

Gas Matters at Peebles.—The Peebles Gas Commission have increased the wages of their workers. An amended estimate was submitted for the current year showing a probable deficit by May, 1918, of £336. This is ascribed to the continued decrease in the consumption of gas, and higher outlay on wages and coals. After consideration, it was agreed not to increase the price of gas in the meantime, and that the deficit incurred at the end of the year be carried forward.

Wages Arbitration at Halifax.—The Committee on Production award, after arbitration, on the demand of workmen in certain departments—including that of gas—of the Halifax Corporation, is for a further advance of 3s. per week to adult workers, making a total of 12s. above pre-war rates. Youths under eighteen are awarded 1s. 6d. a week advance. The awards are to be regarded as war wages, and dependent on the existence of abnormal conditions; and they are to be taken into account in the calculation of overtime payment. The advances are retrospective to September 1. The men's demands were for advances all round equal to 15s. above pre-war rates, to be retrospective to April 1 last.

Gas Prices in Scotland.—The Dumbarton Corporation have reduced the price of gas 8d. per 1000 c.ft., making the new rate 3s. 4d. The Greenock Corporation are increasing the price 5d. per 1000 c.ft. The Rothesay Town Council have raised the price from 4s. 9d. to 5s. per 1000 c.ft., and have reduced the discount on accounts paid within one month of rendering to 5 p.ct. At Dunoon, it has been decided by the Town Council to re-impose meter-rents, in order to help to meet the deficit on the gas undertaking. The Gas Committee did not at present desire to increase the price of gas, because they found it reduced the consumption. Thornhill gas rates are increased 7½d. per 1000 c.ft., owing to war wages and the higher price of coal.

New Companies.—There are among those recently registered several companies of more or less direct interest to "JOURNAL" readers. British Oils and Smokeless Fuels has a capital of £10,000 (9500 £1 ordinary, and 10,000 1s. deferred shares); the object being to distil coal, to recover oil and other bye-products, to briquette and otherwise deal with the residuals therefrom, to deal in and experiment in low-temperature carbonization, &c. The Protol Parent Syndicate (National Waste Utilization) has a capital of £6000 (5000 cumulative ordinary shares of £1 each, and 20,000 deferred shares of 1s. each); Rustless Iron (Cowper-Coles Process), of £5500 (5000 7½ p.ct. cumulative preference shares of £1 and 10,000 ordinary shares of 1s. each); and the Paper Tube and Box Company, of £5000 in £1 shares.

Lurgan Gas Price.—A special meeting of the Lurgan Urban Council decided to apply for a Provisional Order to amend the Lurgan Urban District Council Act, 1915, so as to enable the charge to the gas consumer to be raised above 4s. 6d. per 1000 c.ft. Mr. W. Tallentine (the Gas Manager) referred to the increased price of coal and other materials, and to the higher wages bill. The extra coal price alone, he said, would mean an addition to the production cost of 3d. per 1000 c.ft. At present the price of gas in Lurgan was lower than in most Ulster towns. The Chairman (Mr. H. G. MacGeagh, D.L.) said the new Order would give power to increase up to 6s. 6d. Mr. Waite, who opposed the motion, held that the ratepayers, having agreed to the purchase of the gas-works, should pay any deficits in connection with the undertaking. In Lurgan, 1d. in the pound produced £120; and he, as a ratepayer, would prefer to pay 2d. or 3d. extra rather than charge individuals 1s. or 2s. more per 1000 c.ft. for gas.

Southampton Gas Light and Coke Company.—The report of the Directors for the half year ended June 30, which was presented at the recent meeting, stated that the sale of gas showed an increase of 29,769,000 c.ft., or 6·74 p.ct. Insurance charges for the carriage of coal and oil, the cost of all materials, carbonizing wages, and war allowances to employees, have largely increased. Better returns from residuals have, to a small extent, assisted to meet the heavy expenditure. The profits for the half year amounted to £11,930 (a decrease of £5992 as compared with the corresponding period of 1916), to which was added £1955 18s., the undivided balance at Dec. 31, and £195 interest received, making a total of £14,081. The balance available for dividend on the ordinary stock, after payment of debenture interest and other charges, was £11,171. The Directors proposed to withdraw £5021 from the reserve fund, and recommended the payment of the maximum dividend on the ordinary stock at the rate of 5 p.ct. per annum for the half year.

The Spenborough District Council, with three dissentients, last week accepted the Gas Committee's recommendation for additions to the vertical retort-settings at the gas-works, at a cost, it was stated, of several thousands of pounds, to be paid for out of revenue. It was urged by the Chairman of the Committee (Mr. J. Hirst) that the extension was absolutely necessary, if the local demand was to be met.

At a Todmorden inquest last week, it transpired that Edith Skerratt, aged 23, who had been working on munitions at Coventry, determinedly committed suicide by gas poisoning; the gas being turned on at full, and all crevices in the room being blocked. Under her pillow was found a letter announcing the death in France of her soldier sweetheart. A verdict was returned of "Suicide while temporarily insane."

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MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS.

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Nelson Meter Works, MANCHESTER.

Radford Meter Works, NOTTINGHAM.

Tubs for Tommies.

Reviewing in the "Pacific Service Magazine," the proceedings at the twenty-fifth annual convention, Mr. Henry Bostwick, the Secretary of the Pacific Coast Gas Association, remarks that one feature which stood out above all others was the presence of Captain R. W. A. Brewer, of the Engineering Corps of the British Army, who is on the Pacific Coast in the interest of his country. Captain Brewer presented a paper entitled "Some Notes on the Industrial Use of Gas in England;" and in appreciation of his ability as a gas engineer, and also in recognition of the efficient service which he is performing, the convention elected him an honorary member of the Association. In connection with the presence of Captain Brewer, it was brought to the attention of the members that their "British cousins" have been soliciting funds for what are termed "Tubs for Tommies," the purpose of which is to provide tubs, stoves, boilers, and all the necessary bathing equipment, including disinfectants, for the use of the men in the first line trenches, so as to enable them to have a bath each day. In support of this movement, the members present subscribed an amount aggregating $400, which will be sufficient to provide two units, one of which will be known as the "Pacific Coast Gas Association Unit," and the other as the "Harry L. Strange Unit of the Pacific Coast Gas Association."

An Extensive Thorium and Mantle Business at Chicago.

Some details respecting the Lindsay Light Company of Chicago, published in the "Gas Record," include the statement that they supply over one-half of the thorium used for mantle manufacture in the United States and Great Britain. The output in 1916 was equivalent to 127 million mantles—the largest of any similar enterprise in the world. The Company have long been known as a leading mantle manufacturer; but prior to the outbreak of war their thorium production was comparatively limited. They had, however, been able to secure the large supply of high quality monazite sand in the Travancore district of India which formerly enabled German manufacturers to take the lead, and consequently the Lindsay Company now figured prominently in the world's thorium trade. The thorium refinery now exceeds the mantle department in extent and importance. More than eighty men and twelve great vats are in operation twenty-four hours per day, to meet the American and English demand. The consumption of monazite is about 2½ tons daily. London representatives (Messrs. Paul Winn & Co., Ltd., of 72, Mark Lane, E.C.) direct the sales in Europe. Only one shipload has been hit by the enemy U boats, and so far not a single cargo of this valuable mineral has been sunk on its way from India. The Company have just declared the regular quarterly dividend of 1¾ p.ct. on the preference, and 3, *plus* 17 p.ct. extra, on the ordinary, shares.

Oriental Gas Company.

In recommending a dividend of 4⅛ p.ct. (less income-tax), making with the dividend already paid a total of 8 p.ct. for the year, the Directors of the Oriental Gas Company will report at the shareholders' meeting to-morrow that the conduct of the Company's business for the year to June last was attended by restrictions and obstacles, opposed by war conditions, in no degree less formidable than those of the preceding financial year. The Directors, "although debarred from attaining the complete measure of their objectives, have been able to maintain a full supply of standard quality gas, and thus to meet all the requirements of the military and civil authorities and of the private consumers." The gas-rental realized showed a small reduction below that of the year 1915-16; but this was heavily counterbalanced by the increased returns yielded by the residual products. The balance of revenue account carried to the credit of profit and loss, after allocating £5000 to a "Renewals Suspense Account," was £26,077, or £874 more than the corresponding figures of the previous year. It is pointed out that operations in the nature of extensions and other work properly assignable to capital have been limited by the difficulty (and in some cases the impossibility) of obtaining materials. Such expenditure as has been incurred has been defrayed out of the revenue of the year. The favourable rate of exchange produced an increment of £665 to the equalization account. Acting in conformity with the provisions of the Lands Acquisition Act, the Directors have sold to the Government of India a parcel of surplus land, realizing £4107—a sum which has been carried to the credit of the capital account.

Steps are being taken in the mining districts to facilitate the removal of men where the pits are overcrowded, and from those places where there is irregular work and waste of man-producing power owing to the shortage of tonnage or trucks to get the coal away. These men are to be asked to work in other districts where the pits are undermanned.

The Walsall Corporation Gas Committee report that they have repeatedly drawn attention to the desirability of incandescent lighting being adopted generally, not only to meet the request of the Ministry of Munitions that everything possible shall be done to increase the production of toluol, which is required for high explosives, but also (in the consumers' own interests) to save gas and at the same time obtain a better light.

The Guildford communal kitchen, opened last Tuesday by the Mayor (Mr. W. Shawcross), provides accommodation for fifty people to consume meals on the premises, and will be open daily, except Sundays, from 12 to 2 o'clock. Alderman Patrick said the Committee felt they had done one of their best day's work when they secured the services of Miss Cleasby as their Honorary Superintendent. Mr. P. C. Cleasby (the Engineer of the Guildford Gas Company) had been responsible for the whole of the appliances, and the fitting-up of the kitchen generally. The kitchen is worked entirely by gas; and the cooking apparatus has been supplied by Messrs. Fletcher, Russell, & Co., Ltd., of Warrington. The movement is being run on purely voluntary lines, so far as the management is concerned; and the facilities afforded are much appreciated—no less than 370 portions being sold on the first day.

By Appointment.
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Carron Gas Fires possess all those features that go to make A PERFECT FIRE, including:—

¶ COMPLETE SILENCE
¶ INTENSE HEAT
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The Company's new season's pamphlet—free on request—gives full particulars of these and other popular Carron Gas Fires.

CARRON COMPANY Works: CARRON, STIRLINGSHIRE, and Phoenix Foundry, Sheffield.

FOUNDED 1759. INCORPORATED BY ROYAL CHARTER 1773.

No. 597 Fire.

Mansfield Gas Charges Increased.—The Mansfield Town Council have accepted a recommendation from the Gas Committee that, from Jan. 1 next, the price of gas be increased 9d. per 1000 c.ft. The advance is due to the much heavier cost of production.

New Gas-Making Plant at Tottenham.—The following is taken from the last issue of the "Tottenham Weekly Herald:" The supply of gas in the area covered by the Tottenham District Light, Heat, and Power Company, has been extremely unsatisfactory of late; and while we hear of endless complaints, yet most fair minded and reasonable people appreciate the immense difficulties with which the Company are faced. We have Mr. A. E. Broadberry's assurance that the Company fully expect, during this week, to arrive at the end of most of their troubles. A large new section of works for producing a much higher quality of gas is just about to be put into operation. It was to have been installed in September, 1915, but owing to war difficulties and delays, it is now more than two years overdue. In the meantime, the old plant, which required renovations and repairs, has had to keep carrying an increased burden, and has gradually become so utterly worn out that during the last two months it has been impossible to meet the demands satisfactorily. The Company feel grateful to the consumers for having borne the inconvenience so patiently.

Rise in Price at Scarborough.—The Scarborough Gas Company intimate that, in consequence of the increased cost of coal, the higher rates of wages now paid, and the fact that at the end of this year the Company's reserve fund will be reduced to a point beyond which it would not be prudent to go, the gross price of gas will be advanced to all customers within and outside the borough by 6d. per 1000 c.ft. after the December meter-readings.

Increased Price at Leeds.—The Leeds Gas Department have announced the following increases in gas charges, as from the last meter-reading in December: For motive power and furnace work, from 1s. 11d. to 2s. 3d. per 1000 c.ft. For lighting, heating, and cooking by ordinary meter, in respect of each tenement, outside the city: Stourton, from 3s. 6½d. to 3s. 10d.; Adel, from 3s. 7½d. to 3s. 11d. By ordinary meter, within the city, where the consumption is under 500,000 c.ft. per quarter, from 2s. 9½d. to 3s. 1d.; above 500,000 and under 750,000 c.ft., from 2s. 8½d. to 3s.; above 750,000 and under 1,000,000 c.ft., from 2s. 7½d. to 2s. 11d.; above 1,000,000 and under 2,000,000 c.ft., from 2s. 6½d. to 2s. 10d.; above 2,000,000 c.ft., from 2s. 5½d. to 2s. 9d. By prepayment meter, within the city, from 3s. to 3s. 4d.; and at Stourton, from 3s. 10d. to 4s. 2d. By prepayment meter with cooker, within the city, from 3s. 3d. to 3s. 7d.; at Stourton, from 4s. 1d. to 4s. 5d. per 1000 c.ft.

STOCK MARKET REPORT.

A REVIEW of the aspect of things on the Stock Exchange last week might almost be condensed into two words—No change. Business remained just as limited in volume and as dull and inanimate in character as it was the week before. The same influential factors were still in operation; and on the War horizon the two dark spots—Italy and Russia—were still enshrouded in gloom. As things were, it was somewhat remarkable that prices kept up as well as they did.

Home Government issues were in good case. The 5 p.ct. Loan rose to 94, with Consols and some other following in moderate degree. Some realization took place later; but a recovery landed them firm at the close. Home Rails were torpid and scarcely moved at all. Americans and Canadians were fair on the whole, but movements were irregular. Argentines were dull on labour questions, but rallied later in view of higher rates.

In the Foreign Market, French receded on the Government defeat, but recovered smartly on the new formation. Russians went this way and that, in the obscurity as to what is really happening out there. Among the Miscellaneous group, Oils closed strong, and Rubber steadied after some variable movements. Iron and Steel, Shipping, and Textile concerns were well supported. Coalite, Ltd., which was being dealt in two or three weeks ago, again came into notice through an agreement with Low-Temperature Carbonization, Ltd., which amounts to something more than a working arrangement and less than an amalgamation.

Business in the Gas Market was on a rather larger scale than the week before, but would still bear a little more quickening up. However, the tone did not suffer from this limitation, prices for bargains in nearly all cases being above the latest previous. In quotations, Gas Light ordinary advanced one point, Monte Video ¼, Newcastle ½, and Southampton 2½. Primitiva was ¼ lower. In the Money Market, short loans were easier at the close. Discount rates were steady.

Bargains done for cash during the week were as follows: On Monday, Brentford "B" 76, Commercial 4 p.ct. 71, 71¾, ditto debenture 53¼, 53¾, Gas Light ordinary 70½, 70⅝, 71, Imperial Continental 89⅜, 90, 90½, Monte Video 7¼, Portsea "C" 75⅝, South Metropolitan 75¾. On Tuesday, British 32½, Gas Light ordinary 70⅜, ditto preference 70⅝, Imperial Continental 90, ditto debenture 65½, Primitiva 36s. 3d., ditto debenture 78½, 78¾, South Metropolitan 75, 75½, ditto debenture 56¼, Reading 5 p.ct. maximum 78, 78½. On Wednesday, Bombay £5 0s. 6d., British 32¾, Continental Union 40⅜, European 10⅞, Gas Light ordinary 70½, 71, 71⅛, ditto maximum 57, 57½, ditto debenture 56⅜, Imperial Continental 90, 90½, Metropolitan of Melbourne 99½, 99⅜, South Metropolitan 74⅜, 75½, 76, ditto preference 95⅜. On Thursday, Brentford "B" 73, Gas Light ordinary 71, ditto preference 71, ditto debenture 55½, Imperial Continental 89½, 90, 90⅛, 90½, Newcastle 75, Primitiva preference 57s. 6d., South Metropolitan preference 95, ditto debenture 56, 56¼, Brentford 5 p.ct. mortgage 95. On Friday, Continental Union preference 61½, Gas Light ordinary 70⅝, 71, 71½, 71⅜, ditto maximum 57⅜, Imperial Continental 89½, 90, 90⅛, South Suburban preference 75, ditto debenture 86.

The Bank rate is 5 p.ct., as fixed on April 5.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue. £	Share.	When ex-Dividend.	Prev. Div. or Div. & Bonus. p.c.	Last Dividend.	NAME.	Closing Prices. July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
175,472	Stk.	Mar. 10	4	4%	Aldershot 4 p.c. Pref.	..	57—62	..
1,551,868	,,	April 8	2½	4⅜	Alliance & Dublin Ord.	59—64	52—57	..
374,000	,,	July 10	4	4%	Do. 4 p.c. Deb.	76—79	57—62	..
280,000	5	April 29	7½	3/6	Bombay, Ltd.	5⅞—6⅜	4⅛—5⅜	10/6
50,000	10	Feb. 26	16	14%	Bourne-mouth Gas and Water: 10 p.c.	29—30	23—25	..
383,110	10	,,	7	7%	Bourne-mouth Gas and Water: B 7 p.c.	15—15½	10½—11	..
115,000	10	,,	6	6/-	Bourne-mouth Gas and Water: Pref. 6 p.c.	13½—14	9—9½	..
159,740	—	—	—	4%	Bourne-mouth Gas and Water: 4 p.c. Deb.	..	6½—7½	..
992,045	Stk.	Feb. 26	14	5⅔%	Brentford A Consolid.	261—266	79—82	..
734,920	,,	,,	11	4⅜%	Do. B New	204—209	76—79	73—76
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109—111	81—86	..
221,400	,,	June 11	4	4%	Do. 4 p.c. Deb.	91—93	65—67	..
217,380	,,	Feb. 26	11	10%	Brighton & Hove Orig.	208—213	145—150	..
244,200	,,	,,	8	7%	Do. A Ord. Stk.	154—159	98—103	..
530,000	20	Mar. 26	12½	22/6	British	44—45	32—33	32½
120,000	Stk.	June 26	4	4%	Do. 4 p.c. Deb. Stk.	88—90	68—70	..
245,771	,,	,,	4	4%	Buenos Aires 4 p.c. Deb.	85—87	59—56	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1½—2½	3—3½	..
100,000	10	—	—	4⅛%	Do. 4½ p.c. Pref.	4—6	6¼—7½	..
100,000	Stk.	June 26	4½	4⅛%	Do. 4½ p.c. Deb. Stk.	70—75	60—65	..
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108—110	79—81	..
1,513,280	,,	Feb. 12	5/9/4	44/-	Commercial 4 p.c. Stk.	106—108	70—72	71—71½
560,000	,,	,,	5½	40/-	Do. 3½ p.c. do.	103—105	64—66	..
475,000	,,	June 11	3	3%	Do. 3 p.c. Deb. Stk.	69½—71½	52—54	53½—53½
800,000	,,	,,	4	—	Continental Union Ltd.	76—79	39—41	40⅜
300,000	,,	,,	7	—	Do. 7 p.c. Pref.	115—118	61—63	61½
278,400	—	—	—	11⅛%	Croydon B and C 7 p.c.	..	165—175	..
—	—	—	—	10%	Do. E	..	..	..
492,270	Stk.	—	6	5⅓%	Derby Con. Stk.	123—125	95—100	..
55,000	,,	—	4	4%	Do. Deb. Stk.	102—104	80—83	..
1,002,180	10	July 29	10	5/0	European, Ltd.	17⅞—18	10½—11½	10⅝
16,313,430	Stk.	Feb. 10	4/17/4	37/4	Gas Light & Coke: 4 p.c. Ord.	98—102	70—72	70½—71⅜
2,600,000	,,	,,	3½	3⅛%	Gas Light & Coke: 3½ p.c. max.	76—79	56—58	57—57½
4,062,235	,,	,,	4	4%	Gas Light & Coke: 4 p.c. Con. Pref.	96—99	70—72	70⅜—71
4,674,850	,,	June 11	3	3%	Gas Light & Coke: 3 p.c. Con. Deb.	72½—74½	55—57	55½—56⅜
130,000	,,	,,	10	10%	Gas Light & Coke: 10 p.c. Bonds	..	..	..
258,740	,,	Mar. 12	5	3⅛%	Hastings & St. L. 3½ p.c.	87—89	48—53	..
70,000	10	April 29	11	6%	Hongkong & China, Ltd.	16½—16¾	7¼—8½	..
86,600	—	—	—	9%	Hornsey 7 p.c.	..	115—125	..
131,000	Stk.	Mar. 12	7½	7%	Ilford A and C.	151—154	92—97	..
65,780	,,	,,	6⅜	5⅝%	Do. B	115—118	72—77	..
65,500	,,	June 26	4	4%	Do. 4 p.c. Deb.	92—94	65—68	..
4,940,000	,,	May 14	9	4½%	Imperial Continental	150—160	89—92	89½—90½
1,235,000	,,	Feb. 12	3½	3½%	Do. 3½ p.c. Deb. Red.	84—86	65—67	65½
235,242	,,	Mar. 12	6½	6⅛%	Lea Bridge Ord. 5 p.c.	119—121	82—87	..
2,498,905	,,	Feb. 26	10	5%	Liverpool 5 p.c. Ord. A	211—213	82½—83	..
					Liverpool 5 p.c. Ord. B	146—148		
306,083	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	71—73	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4¼—4⅝	3¾—4	..
250,000	100	April 1	4½	4½%	Met. of Melbourne 4½ p.c. Deb.	99—101	88—98	99½—99⅝
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11⅛—12	8—8½	7⅞
1,875,892	Stk.	July 29	4½	4½%	Newcastle&Gatsh'dCon.	98¾—99½	75—76	75
529,705	,,	June 26	3½	3½%	Do. 3½ p.c. Deb.	82—83	61—63	..
55,940	10	Feb. 26	7/14/0	7/0	North Middlesex 7 p.c.	14—15	9½—10½	..
300,000	Stk.	May 14	8	8%	Oriental, Ltd.	117—122	104—106	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7¼—7⅝	2—3	..
60,000	50	Feb. 26	13	12%	Portsea, Island B	128—131	83—88	..
100,000	50	,,	12	11%	Do. C	118—121	73—78	75⅞
52,000	50	,,	10	9%	Do. D	..	..	..
349,980	5	April 29	8	—	Primitiva Ord.	5⅛—6	1⅞—2	36/3
499,960	5	June 26	5	2/6	Do. 5 p.c. Pref.	4⅝—5	2⅞—3⅛	57/6
521,600	100	June 2	4	4%	Do. 4 p.c. Deb.	91—93	78—80	78½—78⅞
—	—	—	—	4%	Do. ,, ,, 1911	..	..	..
346,198	Stk.	June 26	4	4%	River Plate 4 p.c. Deb.	85—87	59—64	..
150,000	10	May 14	6	6/-	San Paulo 6 p.c. Pref.	10½—11	7½—8	..
125,000	50	July 1	5	5%	San Paulo 5 p.c. Deb.	47—49	40—42	..
135,000	Stk.	Mar. 12	10	10%	Sheffield A	223—224	..	..
209,984	,,	,,	10	10%	Do. B	223—224	180—184	..
523,500	,,	,,	10	10%	Do. C	220—222		
90,000	10	May 28	9	6/-	South African	10½—11½	8½—9½	..
6,609,895	Stk.	Feb. 10	5/4/0	46/8	South Met. 4 p.c. Ord.	111—113	74—76	74⅜—76
—	—	—	—	—	Do. Pref.	..	94—96	95½
1,895,445	,,	July 10	3	3%	Do. 3 p.c. Deb.	72½—74½	55—57	56—56½
224,820	,,	Feb. 26	8½	7½%	South Shields Con. Stk.	157—159	137—139	..
952,795	,,	,,	6	4⅜%	S'th Suburb'n Ord. 5 p.c.	114—116	75—77	..
60,000	,,	,,	5	5%	Do. 5 p.c. Pref.	110—112	75—77	75
185,000	—	—	—	4⅝%	Do. West Kent	..	..	..
187,558	Stk.	June 26	5	5%	Do. 5 p.c. Deb. Stk.	116—118	86—88	86
647,740	,,	May 14	5	5%	Southampton Ord.	99—102	75—77*	..
120,000	,,	Feb. 12	7½	5½%	Tottenham A 5 p.c.	135—138	92—97	..
782,275	,,	,,	6	4%	Tottenham B 3½ p.c.	115—117	70—72	..
181,255	,,	June 26	4	4%	Tottenham 4 p.c. Deb.	87—89	63—65	..
182,380	10	Dec. 30	5	—	Tuscan, Ltd.	5—6	1—2	..
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	93—95	60—65	..
236,476	Stk.	Mar. 12	5	5%	Tynemouth 5 p.c. max.	103½—109½	89—91	..
30,000	,,	Feb. 26	8⅜	72/6	Wandsworth, Wimbledon, and Epsom—Wandsworth A 5 p.c.	151—156	112—117	..
255,636	,,	,,	6⅜	57/6	Do. B 3½ p.c.	129—134	97—99	..
108,075	,,	,,	5/17/3	50/9	Do. C 3½ p.c.	110—115	84—89	..
852,000	,,	,,	6½	51/3	Wimbledon 5 p.c.	117—123	85—90	..
98,000	,,	,,	6⅜	57/6	Epsom 5 p.c.	131—136	93—98	..
88,416	..	June 26	3	3%	3 p.c. Deb. Stk.	60—64	50—53	..

* Ex Div.

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Dated this 14th day of November, 1917.

W. PERCIVAL JONES,
Town Clerk.

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